72 Mar. 29. Argued Collier for appt
Stoughton for appt

16

72 Apr 3. Patent Instained 5-3- (2 doubtings affirm)
Recd as to damages Strong.

TRANSCRIPT OF RECORD.

SUPREME COURT OF THE UNITED STATES.

No. ~~349~~ 148

ALBERT L. MOWRY, APPELLANT,

vs.

ASA WHITNEY.

APPEAL FROM THE CIRCUIT COURT OF THE UNITED STATES, FOR THE SOUTHERN DISTRICT OF OHIO.

FILED DECEMBER 7, 1870.

Contr. Ex. Exceptions p 144 in Suppl
Ex. to Reading 1.
Compl. Ex. p 97
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1 At a circuit court of the United States, within and for the sixth judicial circuit and southern district of Ohio, begun and held at the court-house, in the city of Cincinnati, in said district, on the first Tuesday in October, being the fourth day of that month, in the year of our Lord one thousand eight hundred and seventy, and of the independence of the United States of America the ninety-fifth—present, the Honorable Noah H. Swayne, one of the judges of said court—among the proceedings had were the following, to wit:

ASA WHITNEY
vs.
ALBERT L. MOWRY. } 534. Chancery.

Be it remembered that, heretofore, to wit, on the twenty-first day of March, in the year of our Lord one thousand eight hundred and sixty-six, came the complainant, by S. S. Fisher, esq., his solicitor, and filed in the clerk's office of said court his certain bill herein, which said bill is in the words and figures following, to wit:

2 In the circuit court of the United States for the seventh circuit and southern district of Ohio. In equity.

ASA WHITNEY
vs.
ALBERT L. MOWRY. }

To the honorable the judges of the circuit court of the United States for the southern district of Ohio:

Asa Whitney, a citizen of the State of Pennsylvania, and residing in the city of Philadelphia, in said State, brings this, his bill of complaint, against Albert L. Mowry, a citizen of the State of Ohio, residing at Cincinnati, in said State of Ohio.

And thereupon your orator complains and says:

I. That, before the twenty-fifth day of April, A. D. 1848, he was the the original and first inventor of a new and useful "process for prolonging the time of cooling, in connection with annealing cast-iron railroad car wheels," said process, which is fully described in the letters-patent of the United States hereinafter mentioned, not having been known or used before his invention thereof.

II. That being so, as aforesaid, the original and first inventor of said process, and being also a citizen of the United States, your orator made application, in due form of law, to the Commissioner of Patents for
3 letters-patent of the United States therefor, and on the twenty-fifth day of April, in the year one thousand eight hundred and forty-eight, (1848,) letters-patent of the United States, numbered 5,531, signed, sealed, and executed, in due form of law, were issued to him for said invention, whereby there was granted and secured, or intended so to be, to your orator, his heirs, administrators, and assigns, for the term of fourteen years from and after the date of said letters-patent, the full and exclusive right and liberty of making, constructing, using, and vending to others to be used, the said invention, a description and specification whereof were annexed to said letters-patent, as will more fully appear by reference thereto, or to a duly authenticated copy thereof ready in court to be produced, and a true copy whereof is hereto annexed, marked A, and made part of this bill.

III. And your orator further shows unto your honors, that he has been continuously engaged, ever since the aforesaid twenty-fifth day of April, A. D. 1848, in the manufacture of railroad car wheels, by the process patented to him as aforesaid, and is now still so engaged, and has so made large numbers of such wheels, and has introduced them into public use upon railroads in various parts of the United States, with profit to himself and to the great benefit and advantage of the public; that save, as hereinafter set forth, he has been for about eighteen years, and now is in the undisturbed exclusive possession, use, and enjoyment of the rights secured, or intended to be secured to him by his aforesaid letters-patent, during the term for which they were granted, and during so much of the extended term of said letters-patent as has expired, the said letters-patent having been extended, as hereinafter set forth; and that but for the infringement by the defendant herein complained of your orator would have been, and would be, enabled greatly to extend the manufacture, sale, and use of his car wheels, and to have had and to have correspondingly enlarged profits therefrom.

IV. And your orator further shows unto your honors that, early in the year 1855, he learned that one George H. Thacher, of Albany,
4 in the State of New York, was engaged in making car wheels by a process which your orator deemed to be an infringement of his said letters-patent, and a violation of the rights secured or intended to be secured to him thereby, and which process was, as your orator was informed and believes, as follows: The wheels were cast in the usual manner, in moulds, having an outer metallic ring to form the tread and flanch of the wheels, to harden the same by what is known as the chilling process, about six wheels being poured or cast by one set of men, who took them out of the moulds or flasks as soon as they were sufficiently cool or set to admit of their being removed, but while they were yet red hot. The sand was scraped off to expose the red hot metallic surface, and in this state the wheels were let down into a cylindrical pit one by one, the first wheel resting upon a layer of charcoal at the bottom of the pit, which charcoal was immediately ignited by the red hot wheel and burned freely; this wheel was then covered, all except the hub, with charcoal, and the space between the casing of the pit and the rim of the wheel filled with the same material. Another wheel was then let down upon the charcoal, covering the first wheel, and this second wheel was in turn covered and filled in with charcoal, as before, the third wheel being laid upon this third layer of charcoal and covered with the same material, and so on until six wheels were placed in the pit, which was its full capacity. The upper surface of the top wheel, except the hub, was in like manner covered with charcoal, and the charcoal covered with a layer of sand. The sand cores of the holes in the hubs of the wheels having been previously scraped out and the wheels being placed in a vertical pile in the pit, there was of course a hole or opening through the hubs of the wheels from the bottom to the top of the pit. The pit being thus charged with the series of wheels at a red heat, with the layers of charcoal beneath and above each wheel, the charcoal becoming ignited, produced a high degree of heat, which increased as the combustion of the charcoal became more thorough and complete, thus equalizing the temperature of all parts of each wheel and bringing them to an
5 equal tension, so that in cooling all the parts cooled and contracted equably, preventing all inherent strains. The wheels were suffered to remain undisturbed in the pit until the third day, and were then taken out. The casings of the pit were made—some of sheet iron, some of cast iron, in staves, of a cylindrical form, and a little larger than

the diameter of the wheels to be annealed. They were sunk in the floor of the foundry.

That, in July, 1855, he commenced a suit in the circuit court of the United States for the northern district of New York, against said George H. Thacher, for infringing your orator's aforesaid letters-patent, as above described, and to obtain compensation for its use by said Thacher. That said Thacher, by his pleas, answer, and notices, denied that your orator was the original and first inventor of the process described in said patent, and denied the validity of said patent, for the reasons set forth in his answer, pleas, and notices, upon which allegations the parties were at issue; that a large amount of testimony was taken on both sides preparatory to trial; but the said defendant utterly failing to establish any ground of defence, subsequently, to wit, in November, 1856, applied for a settlement, and settled with the complainant for the infringement as aforesaid of said letters-patent and paid him therefor, and agreed to desist, (whereupon said suit was discontinued,) and has since desisted, as your orator is informed and believes, from further violation of said letters-patent and of your orator's exclusive rights under the same.

V. And your orator further shows unto your honors that, before the twenty-fifth day of April, A. D. 1862, he being desirous of an extension of the term of said letters-patent, made application therefor in due form of law to the Commissioner of Patents, and complied therein, in all respects, with the requirements of the acts of Congress in such case made and provided; and that such proceedings were had upon said application that afterwards, to wit, on the seventh day of April, A. D. 1862, the said Commissioner did extend and renew the aforesaid letters-
6 patent for the further term of seven years from and after the expiration of the term for which they were originally granted, that is to say, for seven years from and after the twenty-fifth day of April, A. D. 1862, by making a certificate of such extension upon said letters-patent in due form of law, as will more fully appear by reference to said letters-patent and said certificate of extension indorsed thereon, or to a duly authenticated copy of said certificate, ready to be produced in court as your honors may direct, and a true copy of which is hereto annexed, marked B, and made part of this bill.

VI. And your orator further shows unto your honors that, as he has been informed and believes, the said defendant, well knowing the premises, and the rights secured by said letters-patent, and the rights of your complainant, as aforesaid, but contriving to injure your complainant, and to deprive him of the benefits and advantages which might and otherwise would accrue to him from said invention, not only since the year 1848, and before the extension of your orator's aforesaid patent, but also since such extension, and before the commencement of this suit, without license and allowance from, and against the wish of, your complainant, and in violation of his rights and in infringement of his aforesaid letters-patent, and in defiance of his remonstrances, has been, and now is, engaged at Cincinnati aforesaid, and within the said southern district of Ohio, in practising and using the process of annealing and prolonging the time of cooling of cast-iron railroad car wheels, described and claimed in the letters-patent granted to your orator, as aforesaid, and has caused, and still causes, the same to be done to a very great extent.

But your orator is informed and believes that said defendant claims, or pretends that, in some manner, to wit, in not using a previously heated furnace or chamber, he avoids following exactly the process described by this complainant. But your orator avers and charges that

the said pretence is unfounded, and that the wheels so made by said defendant have been, and are, subjected to the process described
7 by your orator as aforesaid, or to a process substantially and practically similar in its nature, and the same in its effects. And your orator further shows that, notwithstanding his remonstrances, as he is informed and believes, the said defendant threatens to continue using and practising said process, and to cause the same to be used and practised in making a very large number of wheels, and to vend said wheels, and supply the market therewith, to the effect of depriving your orator of sales for his wheels. And your orator says that he has been damaged and injured by such acts of the defendant, and apprehends being further injured by his repetition or continuance of such acts.

VII. And your orator is informed and believes that the said defendant, without his authority and against his will, has in his possession for sale, and has made and sold, and is engaged at Cincinnati, in the State of Ohio aforesaid, in making and selling cast-iron railroad car wheels in great numbers, and has made and sold many thousands of such wheels, all of which have, at some time before the completion of their manufacture, been subjected to the treatment or process described by your orator in his aforesaid letters-patent, or to some treatment or process substantially or practically similar in its nature, and the same in its effects—said process, as practised by said defendant, consisting in taking the wheels from the moulds in which they are cast, before they have become so much cooled as to produce such inherent strain on any part as to impair its ultimate strength, and immediately after being thus taken from the moulds, depositing them in a furnace or chamber, so constructed, of such materials, and subject to such control, that the temperature of all parts of the wheel deposited therein may be raised to the same point, when they are allowed to cool so fast, and no faster, than is necessary for every part of each wheel to cool and shrink simultaneously together, and no one part before another; the said furnace or chamber being substantially or practically previously heated, as described in the aforesaid letters-patent granted to your orator.

8 VIII. And your orator further shows unto your honors that great damage and injury have resulted to himself, and great profits have accrued to the said defendant, from the infringement, by him, of said letters-patent, and his unauthorized and wrongful use and practice of the process described and specified in said patent; but the amount of such profits he cannot, with certainty state, but believes the same to be more than thirty thousand dollars, and prays that said defendant may be required to make a full discovery of, and account for, all such profits and damages, and to pay the amount thereof to your complainant; and that unless the defendant be restrained by injunction, still further great and irreparable damage and injury will result to your complainant, by reason of the defendant unlawfully, without his authority, and against his will, infringing said letters-patent, and practising and using the said process, patented to your orator, as aforesaid.

In consideration whereof, and forasmuch as your complainant can only have relief in this court, where matters of this kind are properly cognizable and relievable; to the end, therefore, that the defendant may answer the premises, and, if he can show why your complainant should not have the discovery and relief hereby prayed, and may, upon his corporal oath and according to the best and utmost of his knowledge, remembrance, information, and belief, full, true, direct, and per-

fect answer make, to the following interrogatories hereinafter numbered and set forth, that is to say:

First. Whether the said letters-patent numbered 5531, and dated April 25th, 1848, were granted to this complainant, as hereinbefore stated.

Second. Whether said letters-patent so granted to this complainant, as aforesaid, have been duly extended, according to law, for seven years from and after the 25th of April, 1862, as hereinbefore stated.

Third. Whether the said defendant has, since the date of said letters-patent, to wit, April 25th, 1848, been engaged in the manufacture
9 and sale of cast-iron railroad car wheels, at Cincinnati, Ohio, aforesaid, or elsewhere; and if so, what number of such wheels has he made or sold, or caused to be made or sold, since the aforesaid date.

Fourth. Whether the said defendant, in person, or by his agents or employés, has not been, since the date of said letters-patent, and is he not now, at Cincinnati aforesaid, or elsewhere, in possession of, and also engaged in the manufacture and sale of, cast-iron railroad car wheels, which, before their completion have been, and are, subjected to the treatment or process described and specified in said letters-patent, or to some treatment or process substantially or practically similar in its nature, and the same in its effects. If yea, what number of such wheels has he been, since the date aforesaid, and also, is he now engaged in making, or causing to be made or sold; where he has been so engaged, and what number of such wheels has he in his possession.

Fifth. Whether the said defendant, in person, or by his agents or employés, has not, since the date of said letters-patent, at Cincinnati aforesaid, or elsewhere, sold to others, to be used, or delivered to others to be used, cast-iron railroad car wheels, which, before their completion, had been subjected to the treatment or process described and specified in said letters-patent, or to some treatment or process substantially or practically similar in its nature, and the same in its effects. If yea, what number of such wheels have been so sold or delivered, and where, when, and to whom.

Sixth. Whether the cast-iron railroad car wheels, made or sold as aforesaid, by said defendant, and the wheels which are in his possession for sale, and the wheels which he is making, have not been taken from the moulds in which they were cast, before they had become so much cooled as to produce such inherent strain on any part as to impair its ultimate strength, and immediately after being thus taken from the moulds, deposited in a furnace or chamber substantially or practically previously heated, and so constructed, of such material, and subject to such control that the temperature of all parts of the wheels
10 deposited therein might be raised to the same point, when they were allowed to cool so fast, and no faster, than was necessary for every part of each wheel to cool and shrink, simultaneously, together, and no one part before another, substantially or practically, as described in said letters-patent. If not, wherein does the treatment or process to which the aforesaid wheels, made or sold by the defendant, have been subjected, differ substantially from the process patented to the complainant, as aforesaid, in its nature and in its effects.

Seventh. Describe minutely and in detail the treatment or process practised or used by the defendant in the manufacture of said wheels, and describe and designate all the particulars wherein such process differs from the process described and specified by the complainant in his aforesaid letters-patent.

And your complainant prays that the said defendant, his employés, servants, and agents may be perpetually enjoined from practising or using the process of annealing and prolonging the cooling of cast-iron railroad car wheels, described and specified in the complainant's letters-patent aforesaid; that said defendant may also be decreed to account for and pay to your complainant the gains and profits received by him from practising or using the said process so patented to your complainant as aforesaid, and the damages sustained by him by reason of the defendant's infringement thereof, and that the cast-iron railroad car-wheels now in possession or use of the defendant or his agents may be destroyed or delivered up to your complainant for that purpose.

And that your complainant may have such other and further relief as the equity of the case may require and to your honors may seem meet.

May it please your honors to grant unto your complainant a writ of subpœna, directed to the said defendant, A. L. Mowry, commanding him to appear and answer unto this bill of complaint, and to perform and abide by such orders and decrees in the premises as to the court shall
11 seem meet, and be required by the principles of equity and good conscience. And your complainant will ever pray, &c.

May it please your honors to grant unto your complainant a preliminary or provisional injunction against the defendant, his agents, servants, and employés, and every of them, enjoining and restraining the said defendant, his attorneys, solicitors, servants, agents, and employés, and every of them, to the same purport, tenor, and effect, hereinbefore prayed in regard to the perpetual injunction aforesaid, and from practising or using the process described and specified in your complainant's aforesaid letters-patent, and from making, using, or vending to others to be used, and from causing to be made, used, or vended any cast-iron railroad-car wheels which have been subjected to such process as aforesaid, and from doing any act or thing to evade or infringe the aforesaid letters-patent.

HENRY BALDWIN, JR.,
Solicitor for Complainant.

The defendant is required to answer each of the foregoing interrogatories, numbered 1 to 7, both inclusive.

HENRY BALDWIN, JR.,
Complainant's Solicitor.

S. S. FISHER,
Of Counsel.

12 UNITED STATES OF AMERICA,
Eastern District of Pennsylvania, sct:

Asa Whitney, the above-named complainant, on his solemn oath, saith that the matters and things contained in the foregoing bill, so far as they relate to his own acts and deeds, are true; and so far as they relate to the acts and deeds of others, he verily believes them to be true. And he further saith that he is the original and first inventor of the process of annealing and prolonging the cooling of cast-iron railroad car wheels mentioned in the foregoing bill, as described and specified in the letters-patent granted to him April 25th, 1848, and since extended, and that he does not know or believe that the same was ever known or used before it was invented by him, and that he verily believes that the said defendant is wrongfully infringing his aforesaid patent. And further saith not.

Sworn to and subscribed before me this 14th day of March, A. D. 1866.

BENJ. PATTON,
U. S. Com'r, E. Dist. of Penn'a.

13 EXHIBIT A.—No. 5531.

The United States of America to all to whom these letters-patent shall come:

Whereas Asa Whitney, Philadelphia, Pennsylvania, has alleged that he has invented a new and useful improvement in annealing and cooling cast-iron car wheels, which, he states, has not been known or used before his application, has made oath that he is a citizen of the United States; that he does verily believe that he is the original and first inventor or discoverer of the said improvement, and that the same hath not, to the best of his knowledge and belief, been previously known or used; has paid into the Treasury of the United States the sum of thirty dollars, and presented a petition to the Commissioner of Patents signifying a desire of obtaining an exclusive property in the said improvement, and praying that a patent may be granted for that purpose:

These are, therefore, to grant, according to law, to the said Asa Whitney, his heirs, administrators, or assigns, for the term of fourteen years from the twenty-fifth day of April, one thousand eight hundred and forty-eight, the full and exclusive right and liberty of making, constructing, using, and vending to others to be used, the said improve-
14 ment, a description whereof is given in the words of the said Asa Whitney in the schedule hereunto annexed, and is made part of these presents.

In testimony whereof I have caused these letters to be made patent, and the seal of the Patent Office has been hereunto affixed.

Given under my hand at the city of Washington, this twenty-fifth day of April, in the year of our Lord one thousand eight hundred and forty-eight, and of the independence of the United States of America the seventy-second.

[L. S.] JAMES BUCHANAN,
Secretary of State.

Countersigned and sealed with the seal of the Patent Office.

EDMUND BURKE,
Commissioner of Patents.

The schedule referred to in these letters-patent and making part of the same.

To all whom it may concern:

Be it known that I, Asa Whitney, of the city of Philadelphia, and State of Pennsylvania, have made a new and useful improvement in the process of manufacturing cast-iron railroad wheels, and I do hereby declare that the following is a full and exact description thereof:

My improvement consists in taking railroad wheels from the moulds in which they are ordinarily cast, as soon after being cast as they are sufficiently cool to be strong enough to move with safety, or before they have become so much cooled as to produce any considerable in-
15 herent strain between the thin and thick parts, and putting them in this state into a furnace or chamber that has been previously heated to a temperature as high as that of the wheels when taken from

the moulds. As soon as they are deposited in this furnace or chamber, the opening through which they have been passed is closed, and the temperature of the furnace or chamber, and its contents, gradually raised to a point a little below that at which fusion commences, when all the avenues to and from the interior are closed, and the whole mass left to cool no faster than the heat it contains permeates through, and radiates from the exterior surface of the materials of which it is composed. By this process all parts of each wheel are raised to the same temperature, and the heat they contain can only pass off through the medium of the confined atmosphere that intervenes between them and the walls of the furnace or chamber; consequently, the thinnest and thickest parts cool and shrink simultaneously together, which relieves them from all inherant strain whatever when cold.

The annexed drawings will show the form and size of the furnace or chamber which I have used to perform the process above described. Fig. 1, represents a vertical cross-section of the furnace or chamber, and Fig. 2, a horizontal cross-section of the same, on the line A B. In the former is shown a pile of wheels as they are placed to be annealed. The cover to the furnace being moveable, is raised when the wheels are put in, and is then closed and covered with earth, to prevent the too rapid escape of the heat. The damper in the flue leading to the chimney is also closed, as shown in Fig. 2, after the wheels are put into the furnace, and the opening in the lower wall stopped by an iron plate banked with earth, which prevents the escape of the heat in that direction.

The explanations on the drawings sufficiently describe the other parts of the furnace.

To heat this furnace, I have used anthracite coal, it requiring
16 less than one-fourth of a ton to anneal two tons of wheels. The heat required to perform the process may, however, be obtained by the use of any other fuel that may be less expensive at the place where the process is to be performed; or the requisite heat may be taken in a suitable conduit from the furnace in which the metal is melted from which the wheels are made, after it has performed that office, to the chamber in which the annealing process is to be performed. In either case, however, the furnace or chamber must be made of such form, and have such appendages connected with it, as to enable the operator to control the quantity and intensity of the heat used, by admitting more or less of it into the chamber, and of excluding it entirely.

The advantages resulting from the process of prolonging the cooling and annealing as above described are, that the wheels may be made much stronger, when made of the same weight, than they can be when cast and cooled in the ordinary manner; and railroad wheels, having any form of spokes or disks connecting the rim and hub, if subjected to this process, will not require their hubs to be cast in sections, and the spaces between the sections subsequently filled with some suitable metal, and wrought bands put on to the hub.

Wheels subjected to this process of cooling and annealing will be stronger without bands on their hubs than those of the same weight cast and cooled in the ordinary way, having the wrought-iron bands on. In this way the original cost is diminished, and the wheels rendered more durable than they would be when made in any of the ways heretofore employed.

I do not claim to be the inventor of annealing castings made of iron or other metal, when done in the ordinary way; nor do I claim to be the inventor of any particular form or kind of furnace, in which to perform the process. But what I do claim as my invention, and desire to

secure by letters-patent, is the process of prolonging the time of cooling, in connection with annealing railroad wheels, in the manner above described—that is to say, the taking them from the moulds in
17 which they are cast, before they have become so much cooled as to produce such inherent strain on any part as to impair its ultimate strength, and immediately after being thus taken from the moulds, depositing them in a previously-heated furnace or chamber, so constructed, of such materials, and subject to such control, that the temperature of all parts of the wheels deposited therein, may be raised to the same point, (say a little below that at which fusion commences.) when they are allowed to cool so fast, and no faster, than is necessary for every part of each wheel to cool and shrink simultaneously together, and no one part before another.

A. WHITNEY.

Witnesses:
GEO. WHITNEY.
W. H. TALCOTT.

EXHIBIT B.

Whereas upon the petition of Asa Whitney, of Philadelphia, Pa., for the extention of the within patent, granted to him on the 25th day of April, 1848, the undersigned, in accordance with the 18th section of the act of Congress, approved the 4th day of July, 1836, entitled "An act to promote the progress of the useful arts, and to repeal all acts and parts of acts heretofore made for that purpose," and the act approved the 27th day of May, 1848, entitled "An act to provide additional examiners in the Patent Office, and for other purposes," did, on this 7th day of April, 1862, decide that said patent ought to be extended.

Now, therefore, I, David P. Holloway, Commissioner of Patents, by virtue of the power vested in me by said acts of Congress, do renew and extend the said patent, and certify that the same is hereby extended for the term of seven years from and after the expiration of
18 the first term, viz: from the 25th day of April, 1862; which certificate being duly entered of record in the Patent Office, the said patent has now the same effect in law as though the same had been originally granted for the term of twenty-one years.

In testimony whereof I have caused the seal of the Patent Office to be hereunto affixed, this 7th day of April, 1862, and of the independence of the United States the eighty-sixth.

[L. S.] D. P. HOLLOWAY,
Commissioner.

And thereupon, on said twenty-first day of March, in the year last aforesaid, there was issued out of the clerk's office of said court the writ of subpœna herein, which said writ is in the words and figures following, to wit:

UNITED STATES OF AMERICA,
Southern District of Ohio, ss:

The President of the United States of America to the marshal of the southern district of Ohio, greeting:

19 You are hereby commanded to summon Albert L. Mowry, and to serve upon him the accompanying copies of the bill—notice of motion for injunction and affidavits, citizen of and resident in the

State of Ohio, if he be found in your district, to be and appear in the circuit court of the United States, for the southern district of Ohio aforesaid, at Cincinnati, on the first Monday in May next, to answer a certain bill in chancery, filed and exhibited in said court, against him by Asa Whitney, citizen of and resident in the State of Pennsylvania. Hereof you are not to fail, under the penalty of the law thence ensuing. And have you then and there this writ.

Witness the Honorable S. P. Chase, Chief Justice of the United States, this 21 day of M'ch, A. D. 1866, and in the 90th year of the independence of the United States of America.

Attest:

[SEAL.] JOHN McLEAN, *Clerk.*

MEMORANDUM.—The said defendant is required to enter his appearance in this suit in the clerk's office of said court, on or before
20 the first Monday of May, 1866, otherwise the said bill may be taken pro confesso.

JOHN McLEAN, *Clerk.*

United States circuit court, southern district of Ohio. In equity.

ASA WHITNEY
vs.
ALBERT L. MOWRY.

Notice of motion for injunction.

The defendant above named will please take notice that, on Wednesday, the 28th day of March, 1866, at eleven o'clock in the forenoon, a motion will be made before the Hon. H. H. Leavitt, one of the justices of this honorable court, at his chambers at the court-house, in Cincinnati, for an injunction to issue against said defendant in this suit, restraining and enjoining him, pursuant to and in accordance with the bill of complaint filed in this cause, and that said motion will be made upon said bill of complaint, and the affidavits, papers, and documents filed therewith.

Dated Cincinnati, March 20th, 1866.

Filed March 22, 1866.

Yours, &c.,

SAM'L S. FISHER,
Of Counsel for Complainant.

21

22 In the circuit court of the United States for the seventh circuit and southern district of Ohio. In equity.

ASA WHITNEY
vs.
ALBERT L. MOWRY.

UNITED STATES OF AMERICA,
Eastern District of Pennsylvania, ss:

ASA WHITNEY, being duly sworn, deposes and says: I am the above-named complainant, and sole owner of the letters-patent set forth in the bill of complaint herein. I have kept the right under my patent exclusively and solely for my own use and enjoyment, and wish still so

to do during the remainder of the term for which such letters-patent have been extended, believing that I have furnished and can still furnish to the public a better wheel, at the same price, than can be made by any other process, or by any other manufacturer using my process. I have no licensees under my said patent, and have never had any, or granted to any person the right to use my process, except as follows: In 1849 I granted one license, and in 1851 another, but very soon cancelled and revoked them both, because the licensees did not, in
23 either case, comply with their agreement (which was a special condition with each) that they should make as good wheels as were made by me at Philadelphia, and because their failure so to do temporarily damaged the reputation of my own wheels, as each of the wheels made under said licenses had the following words cast thereon, in raised letters, to wit: "A. Whitney's patent, Philadelphia;" and these licensed wheels being inferior, their discredit extended for a time to my own manufacture.

Since then I have had numerous applications for licenses, which I have uniformly declined and refused, preferring to supply the demand from my own works, which I had erected, and have enlarged from time to time, at great expense, and to avoid the liability to have the reputation of my wheels again impaired. I have thus not only been able to supply the demand for my wheels, but have preserved their reputation and maintained their standard of superiority, while selling them at as low and even at lower prices than were demanded for other wheels made at other points.

Upon being informed of the infringement upon my said patent by said defendant, I remonstrated against the same, and promptly, to wit, in July, 1862, commenced a suit against said Mowry, and filed or caused to be filed in this honorable court a bill; and afterwards, to wit, in June, 1863, obtained an injunction against him by his default in failing to answer thereto. Supposing said injunction was meanwhile continuing in force, I waited for the further progress of said suit, which I left entirely in the hands of my counsel. I was not aware until September, 1865, that said injunction had been set aside, and that the defendant had resumed and was continuing his infringement upon my patent. I have urged said suit as far as I could, and yet am informed and believe that said defendant has not yet filed any answer to my bill therein, although the time allowed him for that purpose by this honorable court expired more than one year ago. Said defendant having so far failed to answer said bill, and being advised thereto by counsel learned in the law, I have directed said suit to be discontinued, and proceed-
24 ings to be commenced anew, so that I may no longer suffer the irreparable loss and damage which I have sustained, and daily sustain, by reason of said defendant's disregard of my said bill, and his continued defiant infringement of my letters-patent aforesaid, and his unauthorized and wrongful use of my invention. The said Mowry, by his unlawful use of my process, damages and injures me, by depriving me of a market for my wheels in the section supplied by him, and which I am ready to supply, as well as by withholding from me the profits accruing to him from his wrongful use of my said rights. The exclusive right to the use of said process, secured to me by said patent, is violated, and the benefit and value of my invention to me has been seriously and irreparably impaired by the defendant's infringement of my patent, and I will be further irreparably damaged and injured by his continuance of such infringement. And further saith not.

ASA WHITNEY.

Sworn to and subscribed before me this nineteenth day of March, A. D. 1866.

[SEAL.] CHARLES SERGEANT,
U. S. Comm'r, E. Dist. of Penn'a.

[Five-cent stamp.]

25 In the circuit court of the United States for the seventh circuit and southern district of Ohio. In equity.

ASA WHITNEY
vs.
ALBERT L. MOWRY.

SOUTHERN DISTRICT OF OHIO, *ss:*

The undersigned has, this 28th day of February, 1866, witnessed, by permission of the proprietor, the manufacture of twelve car wheels in the foundry of A. L. Mowry, situated at the southeast corner of East Front and Lewis streets, in the city of Cincinnati.

The wheels A (see accompanying Exhibit X, were cast in the usual combined "chill" and sand mould, two loops, *a* a^1, being formed on one side of each wheel, to enable it to be lifted, while still red hot, into what the operator styles his "carbonizing pit."

This pit has an external cylindrical shell, B, of sheet-iron, about ten feet long, and four feet in diameter; the said shell being open at top, and having a perforated bottom, C, and a lining, D, of fire brick.

The said pit is sunk about six feet, so as to leave about four feet of its height projecting above the ground.

Beneath the perforated floor or bottom of the pit a flue, E, conducts to a smoke-stack.

A bed of charcoal being prepared upon the floor of the pit, a wheel is lowered on to it in a red-hot condition, direct from the sand, and about half a bushel of charcoal is scattered over it, care being taken, by means of a temporary stopper, F, to prevent any particles of coal entering the eye of the wheel.

The stopper F being withdrawn, another wheel is lowered on
26 to the now actively-burning layer of charcoal, which wheel, being covered in like manner, receives another wheel on top of it, and so on until the entire batch or run, say twelve in number, have been disposed of.

The wheels being all in position, a pipe, G, is passed down the eyes of the entire series, which are then covered over with a thick layer of charcoal, and closed in by a lid, H.

The office of the pipe G is to conduct a stream of cold air continually down the common axis of the stack of wheels, so as to prevent undue heating of the central portions, and to enable every part to shrink in concert, and without strain.

After closure, the pit is watched occasionally, and more or less draft admitted, as may be thought desirable.

At the expiration of about four days the wheels are removed from the pit, their cores broken and extracted, and the temporary loops *a a* struck off.

The object and effect of the operation is to anneal the body of the wheel without injuriously affecting the chill of the flange and tread.

The chill in some fractured specimens that had not been through the annealing pit appeared to penetrate from half to three-quarters of an inch.

GEORGE H. KNIGHT,
Consulting Engineer, &c.

STATE OF OHIO, *Hamilton Co.:*

On this 28th day of February, 1866, before me, a notary public in and for the said county, personally came Geo. H. Knight, and made solemn oath that the foregoing statement over his signature is true to the best of his knowledge and belief.

[SEAL.] JAMES H. LAYMAN,
Notary Public, Hamilton County, Ohio.

[U. S. int. rev. stamp, 5 cents.]

(Here follows diagram, marked page 26.)

27 In the circuit court of the United States for the seventh circuit and southern district of Ohio. In equity.

ASA WHITNEY
vs.
ALBERT L. MOWRY.

UNITED STATES OF AMERICA,
Southern District of Ohio, ss:

GEORGE H. KNIGHT, having been first duly cautioned and sworn, deposes and says:

I am forty-six years of age, and reside at Cincinnati, Ohio; my profession is that of consulting engineer and solicitor of patents. I have prepared and presented applications for many scores of inventions. I have also assisted in designing a great variety of mechanical devices, and have often given evidence as a mechanical and scientific expert before the United States courts. I am familiar with the principles involved in the art of casting metals, as now practiced.

I am the same George H. Knight who made a deposition in this cause on the 28th day of February, A. D. 1866, describing the defendant's process of making wheels.

A second and subsequent inspection of Mr. Mowry's process, as conducted at his works, shows me that I was mistaken in one or two points of my description under the date named; and, after a careful examination of his appliances, I have prepared an amended sketch, and annex the same hereto, showing the differences thus detected.

After the batch of wheels has been disposed of, and the upper one covered with charcoal, as previously described by me, a disk, I, is placed over the charcoal, this disk I being somewhat less in diameter than the chamber, and having an aperture through its centre coinciding, when the disk is in position, with the holes through the hubs of the wheels.

About a foot above this disk the lid or top is placed over the pit,
28 leaving a space of that extent between the disk and the lid. The lid fits closely over the top of the pit, and is luted with clay. The lid has an apertture through its centre coinciding with the aperture through the disk and the hubs of the wheels. The pipe G is then inserted through the lid, and rests upon the disk I, its upper end projecting about four feet above the lid of the pit. This pipe does not extend through the hubs of the wheels, as I described it formerly, but stops at and rests upon the disk, as above stated. The draught can be directed either through the pipe G, and through the hubs of the wheels from top to bottom of the pit, into the chimney, or from the bottom of the pit

upwards through the hubs of the wheels and the pipe G, (which in this case becomes, as it were, the chimney.)

A door, which is provided near the foot of the main stack, operates to effect this change; while this door remains closed, the draught is downwards into the chimney; when this door is opened, the draught would be upwards through the pit.

Upon careful examination, I observe no other points of difference from my former description, unless I should notice the fact that the pipe G fits loosely in the aperture through the lid H.

I have read a certified copy of the letters patent, No. 5531, granted to Asa Whitney, April 25th, 1848, and believe that I understand the same. At the time of the invention which is the subject of this patent, numerous experiments had resulted in the adoption for railway carriages of the cast-iron wheel, as now prevalent. A wheel of this kind, simply and economically constructed, by a single casting, was seriously impaired in its usefulness by a liability to fly apart or fracture, arising from the unequal tension of its parts in the act of cooling—a defect greatly aggravated by the necessity of casting on a "chill" that portion of the wheel which was to be subjected to the wear and tear of travel. The defect alluded to had been sought to be remedied by the ordinary process of annealing, in which the heat incident to casting is retained by an enveleope of sand or other slow conductor. This, as is well known, proved inadequate, and it is believed that Mr. Whit-
29 ney, in his process thus patented, was the first to effect the complete annealing of the car wheel without impairing the "chill" or the strength of the wheel.

The patentee has described a specific form or embodiment of his invention, such as he had at the time in use—the same being adapted to the employment of anthracite coal as a fuel, but adds: "The heat required to perform the process may, however, be obtained, by the use of any other fuel that may be less expensive at the place where the process is to be performed;" and in view of the patentee's claim, and of my examination of defendant's process, I have to report that the two devices may be considered substantially identical, in details of construction as well as in their mode of operation. The supposed special cooling agent (the pipe G) which appeared to present a slight feature of dissimilitude with Whitney, does not, in fact, exist.

The object and effect of Mowry's process is to anneal the body of the wheel without injuriously affecting the chill of the flange or tread, and while it differs from Whitney's in some non-essential points, is, in all essential particulars, identical with that patented by Whitney. Thus, Whitney finding that in his vicinity the most abundant fuel of a suitable character was the slow-burning anthracite coal, arranged his furnace for active combustion previous to depositing his wheels. Mowry, on the other hand, employing the comparatively quick and intensely burning charcoal, finds it necessary to leave his fuel to be ignited by the first red-hot car wheel deposited in the pit.

Although Mowry's pit may be cold, or nearly so, immediately preceding the insertion of the first red-hot wheel, yet the instant that the wheel touches the bed of charcoal it is enveloped in a body of flame and incandescent matter but little inferior in heat to the furnace in Whitney's illustration, and, being the first inserted and traversed by all the subsequent emanations of combustion from the superadded layers of charcoal, the desired effects are secured in their full efficiency. As for all the wheels afterwards inserted, they are manifestly placed in an already heated furnace.

30 I find in the mode of manufacture of annealed cast-iron wheels practiced by said Albert L. Mowry, all the material features claimed in the aforesaid patent of Asa Whitney—that is to say, the wheels are taken from the mould in which they are cast, before they have become so much cooled as to produce such inherent strain on any part as to impair its ultimate strength, and immediately after being thus taken from the moulds they are deposited in a previously heated furnace or chamber, so constructed, of such materials and subject to such control that the temperature of all parts of the wheels deposited therein may be raised to the same point, when they are allowed to cool so fast, and no faster than is necessary for every part of each wheel to cool and shrink simultaneously and together, and no one part before another. In a word, I find that the process employed by Mowry is, in all material respects, that claimed by the patentee, Whitney, and included in his grant.

GEO. H. KNIGHT.

Subscribed and sworn to before me this 28th day of March, A. D. 1866.

[SEAL.] JAMES H. LAYMAN,
Notary Public, Hamilton County, Ohio.

[Five-cent stamp.]

31 United States circuit court for the seventh circuit and southern district of Ohio. In equity.

ASA WHITNEY
vs.
ALBERT L. MOWRY.

UNITED STATES OF AMERICA,
Eastern District of Pennsylvania, ss:

I, COLEMAN SELLERS, having been duly cautioned and sworn, do depose and say: My profession is that of mechanical engineer. I am thirty-nine years of age, and reside in the city of Philadelphia, (Pennsylvania.) I am a member of the board of managers of the Franklin Institute of the State of Pennsylvania, and of its scientific committee; I am also a member of other scientific societies, and a solicited contributor to some of the prominent scientific journals, both in this country and in Europe. For the last ten years, I have been in the employment of W'm Sellers & Co., machinists, of Philadelphia, being at the head of the engineering department of their extensive works. Previous to my employment by them, I was employed as foreman in the locomotive shops of Niles & Co., at Cincinnati, Ohio, and have been engaged for twenty years in various branches of the iron trade and manufacture. I am practically familiar with the casting and working of iron.

I have examined the patent numbered 5531, and dated April 25th, 1848, granted to Asa Whitney, and believe that I fully understand the same, and the process therein described. I am also familiar with the conduct of said process, as practised by Mr. Whitney under said patent, and in accordance therewith. His invention relates to the annealing and prolonging the time of cooling of cast-iron car wheels.

32 When pig-iron of certain qualities is melted and poured into a mould, part of which is of iron, and the other parts of sand, that portion of the metal coming in contact with the iron part of mould, is rapidly cooled or "chilled," and peculiar crystals are formed

at right angles to the chilled surface, extending into the metal a greater or less depth, according to the quality of iron used. That part of the casting formed in the sand part of the mould shows, however, not the peculiar crystals characteristics of the metal-chilled part, but only the ordinary crystallization observed in all sand-mould castings, and has all the softness and strength of best castings of iron. Pig-iron best adapted to the manufacture of chilled car wheels, shrinks about $\frac{1}{8}$ (one-eighth) of an inch to a foot, in cooling from a fluid to a solid state. In casting car wheels, a mould is used, of which that part forming the tread and flanch (or those parts of the wheel which come in contact with the rail) is made of iron, and the other parts of sand. The melted metal is poured through the gates in the usual way of making castings of iron, until the whole mould is filled. The metal in contact with the iron part of the mould, which part is called the "chill," at once hardens, or "sets" with the peculiar formation of crystals before mentioned. This part of the metal formed in the iron part or "chill" of the mould, and forming the rim or periphery of the wheel, also shrinks as well as hardens at once in the process of rapid cooling and crystallizing, and compresses or pushes back between the rim and the hub that part of the metal formed in the sand part of the mould, and which is still in a semi-fluid state.

After the diameter of the wheel has thus been reduced by the sudden shrinking of the rim, the other parts of the wheel, cooling and shrinking more slowly, strain severely the metal between the already set rim and the hub, and if their cooling is allowed to proceed below a certain temperature, the wheel will be diminished in strength, and if allowed to cool in the open air, will generally be torn apart by these strains.

These inherent strains characterized and rendered imperfect all chilled cast-iron car wheels, previous to the invention of Mr.
33 Whitney's process, and are only imperfectly counteracted by the use of various mechanical devices in the forms of patterns for the wheels, well known to those familiar with this subject.

In the process of manufacture as conducted by Mr. Whitney, in accordance with his patent the wheels of any form of pattern that may be desired, are cast as usual, and as above described.

So soon as the metal has all "set," and become "stiff" enough to be removed from the mould, they are placed in the annealing pits or ovens, which are formed as shown in the drawing hereto annexed. The centre foundation of the oven is formed of common brick, topped with fire brick, and is large enough in diameter to support the wheels to be annealed or cooled. A circular wall supports the shell of the oven, which is formed of a wrought-iron casing lined with fire brick, and can be made of any convenient depth. Near the top of the oven, is a flue, provided with a damper; this flue connects with the chimney. Lids are provided to cover the top of the oven. At the bottom of the oven, the grate bars rest on the outer wall and the centre piece, forming a circular furnace over the ash-pit.

Previous to filling the oven with hot wheels, it is heated by an anthracite coal fire, built on the circular furnace grates, to a dull red heat. After the wheels have been placed in the oven, in a pile, as represented, the lid is put on to cover the oven, and the crack or joint filled with sand to prevent the heat from escaping too fast, and the damper is left open, until all parts of wheels have become reheated to an uniform temperature, which relieves whatever strain may have been produced on the wheels, by their partial and unequal cooling before being reheated. The damper is then closed, and the oven and wheels allowed to cool, by the gradual *espace* of the heat from the surface of the oven. This re-

heating, while it adjusts the strains on the wheels, does not affect or change the peculiar crystallization already described, of the chilled tread and flanch.

Mr. Whitney's invention, consists in this reheating and very slow
34 cooling of the wheels, relieving the strains produced by the primary irregular cooling and retrieving the strength thus endangered by the circumstances, and in the manner hereinbefore described.

I have carefully read the depositions of George H. Knight, sworn to in this cause, February 28th, 1866, and describing the process used by the defendant, and I believe that I fully understand the process of Mr. Mowry, as therein described, and his means of conducting said process, as illustrated by the drawing annexed to said Knight's deposition. It is, in my opinion, in all respects, substantially and practically the same as that used by Mr. Whitney, and described in his patent. Mr. Mowry takes his wheels from the moulds, and while in the same condition of heat, as mentioned by Mr. Whitney, places them in pits, and reheats them, and then allows them to cool slowly and gradually by the permeation of the heat through the walls of the pit. The only difference between the means employed by Mr. Mowry and Mr. Whitney, respectively, is one incident to the different fuels used by them. Mr. Whitney's patent suggests such a difference. He uses anthracite coal, because that is the cheapest fuel at Philadelphia. Mr. Mowry uses charcoal in place of anthracite coal, for perhaps a similar reason, at Cincinnati. Each kind of fuel used to heat the furnace is economized by adapting the furnace to the fuel. Anthracite coal is only combustible at a much higher temperature than charcoal, and ignites slowly, while charcoal ignites almost instantly and burns rapidly. Mr. Whitney uses a fuel, which he ignites long enough before placing his wheels in the pits, to raise the temperature of the pit almost as high as that of the wheels when put in, otherwise the wheels might cool injuriously before his pit was heated. Mr. Mowry uses a fuel which, if used in Mr. Whitney's furnace, would burn out before the pit was heated, and would not arrest the cooling of the wheels. He therefore adopts his method of layers of charcoal, the rapid cumbustion of which begins to raise and equalize the temperature of the wheels, from the moment the first wheel is placed in the pit. This accomplishes the same object as Mr.
35 Whitney's earlier heating of his pits, by his slower fuel, and is substantially and practically the same thing in principle, in mode of operation and in effect, as are the two processes throughout, so far as Mr. Whitney's patent is involved, and while I should deem Mr. Mowry's less perfect, in respect to economy of fuel and ease of management, I am clearly of the opinion, that it embodies the principle, the mode of operation, and the effect of Mr. Whitney's invention, and that he uses substantially and practically the same means of applying that principle, and attaining the results, which are described and specified in Mr. Whitney's patent, and I therefore consider Mr. Mowry's process an infringement of that patent, substantially and practically in all of its features. And further saith not.

COLEMAN SELLERS.

Subscribed and sworn to before me, this nineteenth day of March, 1866.

[SEAL.] CHARLES SERGEANT,
U. S. Commissioner, E. Dist. of Penn'a.

[5-ct. rev. stamp.]

(Here follows diagram, marked page 35.)

Circuit court of the United States for the seventh circuit and southern district of Ohio. In equity.

ASA WHITNEY
vs.
ALBERT L. MOWRY.

SOUTHERN DISTRICT OF NEW YORK, *ss:*

EDWARD S. RENWICK, having been duly sworn, deposes and says as follows, viz: I reside in the city of New York, and am forty-three years of age; I am by profession a consulting engineer, and am engaged principally in preparing applications for letters-patent, in soliciting
36 patents, and in acting as scientific expert in the trial of patent causes in the United States courts. I was engaged for about eight years of my life in the manufacture of iron, and am well acquainted with the processes and means employed in manufacturing iron castings of various descriptions. For the greater part of the past eighteen years I have been engaged in my present occupation, and have been frequently called upon, as expert, to examine and explain inventions of many kinds, and to point out their similarities and differences.

I have carefully examined a certified Patent Office copy of the letters-patent of the United States, granted to Asa Whitney the 25th day of April, A. D. 1848, and believe that I fully understand the process and means therein described for annealing chilled cast-iron car wheels. I have also read what purports to be a copy of the deposition of George H. Knight, made in the above-entitled matter, and sworn to the 28th day of February, A. D. 1866, and believe that I fully understand the process and means therein described as used at the foundry of A. L. Mowry, in the city of Cincinnati.

Upon comparing the said process and means used by said Mowry with the process and means described in the aforesaid letters-patent of Asa Whitney, I find that the two are substantially the same in the following respects, which are, in my opinion, essential to the successful annealing of chilled cast-iron car wheels.

In both a furnace is used to contain the car wheels, and subject them to the action of heat derived from burning fuel.

In both the car wheels are taken from the sand moulds and placed in said furnace before they have cooled down sufficiently to strain the metal by unequal contraction, and while they are in a highly heated state.

In both the furnace is supplied with fuel, for the purpose of developing heat additional to that which exists in the car wheels when placed in it.

In both the furnace has a chamber to receive and hold the car
37 wheels, and in both appliances are used to enable the operator to control the quantity and intensity of the heat used in the chamber. The appliances for this purpose in the Mowry furnace are the doors at the top of the furnace, which, as I understand the description of Mr. Knight, are opened more or less to regulate the draught of air, and thereby control the combustion of the fuel (charcoal) by which the additional heat is developed.

In both the furnace is heated before the car wheels are inserted into it. In the Mowry furnace the insertion of the first red-hot car wheel upon the bed of charcoal, previously placed in the furnace, must c

necessity inflame it, and the charcoal, in burning, must impart heat to the furnace before the remaining car wheels are inserted, so that, although the Mowry furnace may not be heated to so high a degree as is advised in the Whitney patent, it is, nevertheless, heated before the introduction of all the car wheels but the first one, and the difference between the amount of heat is a matter of degree.

In both the time of cooling of the car wheels is prolonged; in both this prolongation is effected by the same means; that is, the supplementary heat derived from burning fuel; and in both the period of prolongation is under the control of the operator.

In both the operation of the process is to maintain all parts of the wheel that are liable to strain at practically the same temperature during cooling, so that strain by unequal contraction does not take place. When making this statement I have not forgotten that the Knight deposition describes the employment by Mowry of a pipe, (denoted by the letter G,) which is inserted through the eyes of the wheel hubs, and that it might at first view seem possible that air drawing down this pipe would cool down the hubs of the wheels. Such a pipe would of necessity become highly heated by its vicinity to the heated wheels, and, consequently, draught through it would naturally tend upwards, so that the tendency of the chimney (with which the pipe G connects at its lower end, through the flue E,) to draw a current of air downwards through the pipe G, would be counteracted in part by the natural tendency of the hot air within it to pass directly
38 upward, and as the pipe is quite small, and is, moreover, heated above the wheels by the fuel that is above the highest wheel, so that air passing downwards through it is heated before it arrives at the level of the highest wheel, I have no doubt that the insertion of the pipe produces no material cooling effect upon the hubs of the wheels, and that the pipe is practically inoperative.

The said deposition of said Knight does not inform me whether or not the heat in the Mowry furnace is raised to a point a little below that at which fusion commences; but I do not consider that omission as material, because, as I understand the Whitney patent, the temperature of a little below fusion is only given as an example of a point at which all parts of the wheel will be of the same temperature, and the Whitney patent does not state that the point of equable temperature may not be reached before the heat arrives at a point a little below fusion.

In conclusion, I am of opinion that the said Mowry process embodies the essential features of the Whitney process described in the aforesaid patent, and that those respects in which the Mowry process and means differ from the precise description contained in said Whitney's patent, are differences in degree and form, and are not material to the successful prolonging of the time of cooling the car wheels by the application of heat derived from fuel. The process pursued by Mowry and Whitney is, in fact, based upon the discovery which, so far as I know, was first made by said Whitney, viz: that the chilled cast-iron, constituting one part of the wheel, could be subjected to a heat less than fusion without producing any material effect upon its hardness, while the cooling of the remainder of the wheel could be so prolonged by the application of heat derived from burning fuel, as to enable all parts of the wheel to cool without being subjected to the strains incident to unequal contraction.

E. S. RENWICK.

Subscribed and sworn to this 17th day of March, A. D. 1866, before me.

[SEAL.] MELVILLE BIGGS,
A Notary Public, duly appointed, and residing in the City of New York, in the Southern District of New York.

[Five-cent stamp.]

39 And afterwards, to wit, on the sixth day of April, in the year of our Lord one thousand eight hundred and sixty-six, came the said marshal to whom the aforesaid writ of subpœna herein was in form aforesaid directed, and returned the same into the clerk's office of said court, with his proceedings endorsed thereon, in the words and figures following, to wit:

I accept service of the within subpœna, & also of a copy of the bill and affidavits of Whitney, Sellers, Renwick, & Knight, on behalf of the defendant, Albert L. Mowry, this 31st day of March, 1866.

CHA'S B. COLLIER.

SOUTHERN DISTRICT OF OHIO, *ss:*

This writ received March 21st, 1866, and service thereof, and also of a copy of the bill and affidavits accepted on behalf of the defendant, Albert L. Mowry, by his attorney, Charles B. Collier, esq., March 31, 1866.

A. C. SANDS, *U. S. Marshal,*
By H. W. BLINN, *Deputy.*

40 ASA WHITNEY, COMPLAINANT,
vs.
ALBERT L. MOWRY, DEFENDANT.

The defendant above named, Albert L. Mowry, being duly sworn, deposeth and saith as follows: That, on the seventh day of May, A. D. 1861, letters-patent were issued to him in due form of law by the Commissioner of Patents of the United States, for a certain new and improved mode of annealing car wheels, theretofore invented by the affiant; that said letters-patent are numbered 1248, and are hereto annexed and marked, "Exhibit A."

And further, affiant saith that for several years he has been manufacturing car wheels, and is now manufacturing them, at his establishment in the city of Cincinnati, in the County of Hamilton, in the State of Ohio, according to his said patented process and under and by virtue thereof, and not otherwise.

Affiant further saith that he has many times carefully read the letters patent (No. 5531) granted to the complainant, Asa Whitney, on the 25th day of April, A. D. 1848, a copy of which are annexed to the complainant's said bill; that affiant, after careful examination, and after many years of practical experience in the manufacture of car wheels, and of observation of the effect of different processes of annealing upon them, does not hesitate to say that the process so used by him, as described in his said letters-patent, differs entirely from the process as described in the complainant's said letters. And affiant states that said processes differ specifically as follows:

1st. In the process of the complainant a furnace is used in connection with the annealing pit, from which furnace, prior to the wheels being removed from the mould, hot air is introduced until the annealing pit

is heated up to a temperature equal to that of the wheels, when they are removed from the mould, which is a very high temperature.

On the contrary in this defendant's process, the wheels are
41 placed in a cold pit, and there is no furnace connected with the defendant's pit. Affiant says that he has read the affidavits taken by the complainant and annexed to this bill, and intended to be used in support of his motion for an injunction in this cause, and does not hesitate to say that, in so far as the same describe this defendant's process as necessitating a practically previously heated pit, such affidavits are wholly incorrect; that, on the contrary, the annealing pit of this defendant does not become heated to a temperature at all corresponding to the heat of the wheels until after the wheels have all been placed in, the cover placed over the pit, and the current of air admitted to promote the combustion of the *interiald* charcoal, and the wheels in defendant's process, when placed in the pit, lose heat rapidly in imparting it to the charcoal, which is placed in contact with them, and to the current of cold air passing downwards; while in complainant's process the wheels gain heat from the moment they are placed in the annealing pit; and these facts this affiant is able to state from actual observation.

2nd. This affiant states that in the complainant's process, after the wheels are placed in the previously-heated pit, hot air is introduced into the annealing pit, from the furnace connected therewith, until the wheels are heated up to a point a little below that at which fusion commences, and that then the avenues to and from the annealing pit are closed tight, and the whole mass left to cool by radiation.

That in the defendant's process, on the contrary, the wheels are at no time after being placed in the annealing pit, heated to a point approximating the point of fusion; if they were so heated it would spoil the chill of the wheels, and render them unfit for use. Nor are all parts of the several wheels in defendant's pit heated to the same degree, as stated to be necessary in complainant's process; but on the contrary, the plates of the wheels in defendant's process being the only parts with which the charcoal is in contact, and being thinner than the
42 hubs and rims, are heated to a greater degree than the other parts, and this natural result is aided by the current of air which is continually passing through the hubs or eyes of the wheel; and affiant states that as the result of his experience, and in order to counteract the strain produced upon the wheels by the sudden contraction of the plates in the moulds, the plates in the annealing pit should be heated to a greater degree than the other parts of the wheels, and that without such increased heating of the plates, the benefits of the annealing process will he materially lost.

And further, affiant states that a great difference exists between the processes of complainant and defendant, inasmuch as the complainant uses hot air only in his annealing pit, whereas the defendant uses charcoal in direct contact with the wheels; and defendant states that by the use of charcoal he produces a chemical effect upon the iron, which strengthens the wheels and renders them vastly safer and more durable than those manufactured by the complainant's process; that in so stating, affiant states that which he has seen demonstrated by practical tests.

Affiant further saith that he is not induced to use charcoal in his process by reason of the economy of it, as stated in one or more of the affidavits produced by complainant, but solely by reason of its ascertained beneficial effect, and that other kinds of fuel could be used with

much less cost to affiant, but without producing the effect produced by his process as now conducted. Affiant could not use anthracite or bituminous coal with his process, as the current of air is not strong enough to cause the combustion.

And further affiant saith not.

A. L. MOWRY.

Sworn to before me and subscribed in my presence this 23rd day of April, A. D. 1866.

[SEAL.] JOHN L. CADWALADER,
Notary Public, City and County of New York.

43 *The schedule referred to in these letters-patent, and making part of the same.*

To all whom it may concern:

Be it known that I, A. L. Mowry, of the city of Cincinnati, in the county of Hamilton, and State of Ohio, have invented a new and improved method of annealing car wheels; and I hereby declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying drawings and letters of reference marked thereon, which form part of this specification.

My invention consists in the use of charcoal or other equivalent substance, interlaid with the wheels in the annealing pits in connection with the regulated admission of air, for the purpose of heating the wheels up to a proper temperature, prolonging the heat and permitting them to cool in the course of a given time, gradually, as will be more particularly explained below.

In order that others duly skilled may be enabled to understand, and construct, and use my invention, I shall proceed to describe it in detail.

In the accompanying drawings:

Fig. 1, is a perspective view of two annealing pits and the necessary flues.

Fig. 2 is a vertical section through the same.

Like letters of reference designate like parts in all the drawings.

A A are two annealing pits, which may be constructed of double metal shells *a a*, with concrete, or other refractory material, *b*, between; or they may be merely built of brick. B is the horizontal flue, communicating with inside of pits by the perforated plates, (in bottom of pit,) *c c*. C is the vertical flue, or chimney shaft, which communicates with horizontal flue B, and may be of any convenient height. D is a cover provided to each pit; in the center of cover is an opening, *d*, which is closed by a damper, *e*. *w w* are car wheels built up in the pits, with charcoal between, and *f*, a perforated cast-iron plate, laid on
44 top of the topmost layer of charcoal, so as to distribute the air admitted equally through the fuel in the pit.

The operation of my invention is as follows: A layer of charcoal having been laid on the perforated bottom *c*, of the annealing pit, the wheels, as they are turned out of the moulds red hot, are placed in the pits, with a layer of charcoal between each wheel, a layer of charcoal being laid on the uppermost wheel and on this a perforated metal plate is laid.

The charcoal, becoming now ignited by the hot wheels, the cover of pit is then laid on, and the damper opened so as to admit just sufficient air to effect the combustion of the contained charcoal, in the space of seventy-two hours, less or more, as may be found necessary for the an-

nealing operation. The draft of air in the apparatus shown on drawings is from above downward, but it may, without affecting my invention, be from below upwards, by conveying the air from the horizontal flue, up through the pits, and through the aperture in cover, and from thence through flues, into the main shaft or chimney C; the result will be the same in both cases, and the adoption of one or the other plan will be dictated by convenience.

It is well understood that chilled car wheels require to be cooled by a process which will permit the different parts to adjust themselves to each other, and accommodate the unequal contraction which results from the process of chilling; for this purpose, the wheels, while still hot, are sometimes placed in pits, and covered with dry sand, which causes them to retain their heat for a considerable time, and, in slowly cooling, the adjustment above referred to takes place.

In other cases the wheels are placed in pits, where they are heated by a furnace, and maintained at a high heat for several days. In other cases they are placed in pits, and a current of air is caused to pass through the center eye of the wheel, which cools the hub more rapidly than the rim is cooled, thus reversing the process which takes place when the wheel is first cast in a mould with a chill surrounding the rim.

All of these devices, and others which it is not necessary to specify, are attended with difficulties and with imperfections which it is the design of my invention to obviate. In the operation of my invention, it is found that the wheels, when removed from the annealing pit, are devoid of any strain from unequal contraction, and that they afford as much apparent resistance to fracture as if they had been cast in an ordinary sand mould, without the use of a chill.

I do not claim as my invention, or any part thereof, the pits, flues, or currents of air, for the purpose herein described; but what I claim as new, and desire to secure by letters-patent is the employment of charcoal, or other equivalent combustible substance, interlaid between the wheels in a pit, in a combination with an aperture, *d*, for regulating the supply of air to the same, so as to prolong the combustion of the fuel, and retain the heat for the purpose herein described.

A. L. MOWRY, *Inventor.*

Witnesses:
THOS. N. WITHINBURY.
WM. CLOUGH.

ASA WHITNEY
vs.
ALBERT L. MOWRY.

UNITED STATES OF AMERICA,
State of New York, City & County of Albany,
Northern District of New York, ss:

GEORGE H. THACHER, being duly sworn, says: That he is between forty-seven and forty-eight years of age; that his occupation has been for the last fourteen years past, and still is, that of manufacturer of car wheels, and of other castings, principally of car wheels, doing business in Albany, in the State of New York; that this deponent has resided in the city of Albany, in the State of New York, for more than fourteen years last past, and still resides in the said city of Albany; that he, this deponent, is acquainted with the improvement for annealing cast-iron car wheels, patented by Albert L. Mowry, the defendant in

this action; that in said improvement the wheels are placed in circular pits, the one above the other, with layers of charcoal between
47 each of the wheels, and the charcoal is ignited by coming in contact with the red-hot wheel, & the cold air is let in from beneath the wheels through a perforated plate, & thereby the combustion of the charcoal is increased; that the cooling of the wheels by this process is prolonged, & thereby the strain or tension which would be on the wheel owing to unequal thickness of its parts is to a great extent obviated or taken from the wheel; that he, this deponent, is acquainted with the improvement of Asa Whitney, having in view the same object as that of the Mowry improvement; that the said Whitney improvement is as follows, viz: A large pit or oven is constructed, which is heated from beneath with anthracite coal to a point of heat near the point which would be necessary to produce the fusion of the iron, as Whitney claims. The oven is thus heated, as Whitney claims, before the wheels are placed in the same, and the wheels are taken from the moulds as soon after they are cast as the iron becomes sufficiently set, & the wheels are then placed in this previously-heated oven, and the time of cooling is thereby prolonged; that, in the opinion of this deponent, the process of annealing cast-iron wheels, as patented by A. L.
48 Mowry, is essentially different from that patented and used by Asa Whitney. 1st. Whitney places his wheels in an oven heated previously to its receiving the wheels; Mowry uses a pit not previously heated, but entirely cold. 2nd. Whitney claims the raising the temperature of the wheels after being placed in the oven to a point a little below the point of fusion. Mowry does not claim to do this, nor can he raise the temperature to so high a point unless he changes his process. 3rd. The raising the temperature to a point little below fusion is, in the judgment of this deponent, a positive injury to the texture of the iron & the strength and durability of the wheel. 4th. The taking the wheels in a heated state from the mould is common to all processes of annealing. It has been done ever since cast-iron wheels were made, whether they were cooled in dry sand or in any other process.

GEO. H. THACHER.

Subscribed and sworn to this twentieth day of April, in the
49 year eighteen hundred and sixty-six, before me.

In witness whereof I, a notary public in and for the said State of New York, duly commissioned and sworn, and dwelling in the said city of Albany, have hereunto subscribed my name, and hereto affixed my official seal, this 20th day of April, A. D. 1866, at my office, in said city of Albany.

[SEAL.]

EDWARD WADE,
Notary Public.

[5-c. I. R. st'p cancelled.]

United States circuit court, southern district of Ohio.

ASA WHITNEY
vs. } 534.
ALBERT L. MOWRY.

Notice of motion for injunction.

You will please take notice that on Monday, the second day of April, 1866, at eleven o'clock on that day, a motion will be made before the

Honorable H. H. Leavitt, one of the justices of this honorable court, at chambers, for an injunction to issue against the defendant in this
50 suit, restraining and enjoining the said defendant pursuant to and in accordance with the prayer of the bill of complaint filed in this cause, and that said motion will be made upon said bill of complaint, and the affidavits, papers, and documents, copies of which were heretofore and are herewith served upon you.

SAM'L S. FISHER,
Complainant's Solicitor.

Dated March 28th, A. D., 1866.
Received copy March 31st, 1866.

CHAS. B. COLLIER,
For Def't.

Filed April 26th, 1866.

51 United States circuit court, southern district of Ohio.

ASA WHITNEY
vs. } 534.
ALBERT L. MOWRY.

The defendant will please take notice that the complainant desires the proof in this case to be taken orally, under the 67th rule in equity, as amended.

SAM'L S. FISHER,
Compl't's Sol'r.

Received copy Mar. 31st, 1866.

CHA'S B. COLLIER,
For Def't.

Filed April 26th, 1866.

52 In the United States circuit court, southern district of Ohio. In equity.

ASA WHITNEY, COMPLAINANT,
vs. } No. 534.
A. L. MOWRY, DEFENDANT.

And now comes the defendant above named, A. L. Mowry, and for answer to the bill of the complainant above named, Asa Whitney, says that it is true, as the defendant believes, that, on the 25th day of April, A. D. 1848, letters-patent, in due form of law, were issued to the complainant by the Commissioner of Patents of the United States, for certain improvements in annealing and cooling cast-iron car wheels, as stated in the complainant's said bill of complaint. And the defendant further says that it is true, as he believes, that the said letters-patent were duly extended for the period of seven (7) years from the 25th day of April, A. D. 1862, as is also stated in the complainant's said bill. And the defendant further states that it is true, as he believes, that the complainant has been continuously engaged for many years, but for just how long the defendant does not know, in the manufacture and
53 annealing of railroad car wheels, but the defendant does not know whether the process employed by the complainant in such manufacture is similar to that described in his said letters-patent.

And further answering, the defendant states that he is informed and believes, that, in the year A. D. 1855, the complainant did, as alleged in his said bill of complaint, commence a suit in the circuit court of the United States for the northern district of New York, against one George H. Thacher, who was then engaged in the manufacture and annealing of car wheels, according to a process which is described with substantial correctness, as the defendant believes, in the complainant's said bill, for the alleged infringement by the said Thacher, in the use by him of his said process of the complainant's said letters-patent. And that it is also true, as alleged in said bill, as this defendant believes, that the said Thacher did, in such suit, by his plea and notice deny that the complainant herein was the original and first inventor of the process described in said patent; and that a large amount of testimony was taken in said cause preparatory to trial; but the defendant does not admit to be true the averment "that said Thacher, utterly failing to establish any ground of defence, subsequently, to wit, in November, A. D. 1856, applied for a settlement and settled with the complainant for the infringement, as aforesaid, of said letters-patent, and paid him therefor, and agreed to desist, and has since desisted, from such further manufacture by him." On the contrary, the defendant is informed and believes, that by reason of the character of the testimony taken on behalf of the defendant, the said Thacher, in said suit, the complainant, said Whitney, became convinced that he could not safely prosecute said suit, and risk the result of an investigation as to the validity of his said letters-patent, or the alleged infringement thereof, and that he did thereupon apply to the said Thacher for a settlement of said suit; that hereupon a settlement was made between said parties, by the terms of which said Thacher did, as this defendant is informed, make a small payment to said Whitney, but that such payment was less than the costs of
54 such suits, and was not made as compensation for an admitted infringement by said Thacher of the complainant's said letters-patent, but as occasioning less expense to him than would be necessary for the further defence of such suit, even in the event of success. That although said Whitney claimed damages in the sum of $60,000, in said suit, he discontinued the same by reason of the character of the testimony taken therein, and paid a portion of the costs thereof.

And this defendant states that there was no judgment rendered in said cause against said Thacher, nor any recognition by him of the validity of the letters-patent of the complainant, nor did he desist from the further employment of his process, as is stated in the complainant's bill herein.

And further this defendant says that, as matter of fact, the process as employed by the said Thacher, as described in the complainant's bill, does not conflict with the process described in the complainant's said letters-patent; but, on the contrary, is wholly different from the complainant's said process, in principle, operation, and effect.

And this defendant, further answering, denies that he has been, or is engaged, at the city of Cincinnati or elsewhere, in practicing and using the process of annealing and prolonging the time of cooling of cast-iron railroad car wheels described and claimed in the letters-patent granted to the complainant as aforesaid; or that he has at any time made or sold railroad wheels in violation of the rights of the complainant, as alleged.

And further answering, the defendant states, that he has been and is engaged in the manufacture and annealing of cast-iron railroad car wheels; and he further says that, prior to the 7th day of May, A. D.

1858, he, the defendant, was the true, original, and first inventor of certain improvements in annealing car wheels, and that the defendant being the inventor of such improvements, and being a citizen of the United States, made application to the proper department of the Government of the United States for letters-patent for the said improve-
55 ments, and having complied with all the requisitions of the then existing laws, on the 7th day of May, A. D. 1858, letters-patent of the United States, in due form of law for the defendant's said invention, were issued to the defendant, were issued to him, whereby there was secured to the defendant, his heirs, executors, administrators, and assigns, for the term of seventeen years from the 7th day of May, A. D. 1858, the full and exclusive right of making, using, and vending to others to be used, the said improvements; a true and correct copy thereof, with the specifications and drawings annexed thereto, is hereto attached, and made part hereof, marked Exhibit A.

And, further answering, the defendant states that he has manufactured and annealed car wheels according to the process described in his said letters-patent, and not otherwise. And in answer to the several interrogations propounded to him by the complainant in his said bill of complaint, the defendant saith as follows, to wit:

To the first interrogatory the defendant saith:

1. The defendant admits that, on the 25th day of April, A. D. 1848, letters-patent were issued to the complainant, as in his said bill set forth.

To the second interrogatory saith:

2. The defendant admits that the letters-patent so granted to the complainant have been duly extended, according to law, for the term of seven years from the 25th day of April, A. D. 1862.

3. The defendant has, since the 25th day of April, A. D. 1848, been engaged in the manufacture and sale of cast-iron railroad car wheels at Cincinnati, in the State of Ohio, during which time the defendant has made and sold, and caused to be made and sold, several thousand wheels, but is not able to state the number, and has not the means at present of ascertaining.

56 4. The defendant has not been, either in person or by his agents or employees, since the date of the letters-patent as issued to the complainant at Cincinnati, or elsewhere, engaged in the manufacture or sale of cast-iron railroad car wheels, which, before their completion, have been subjected to the treatment or process described or specified in said letters-patent of the complainant, or to any process or treatment substantially or practically similar in its nature or in its effects.

5. The defendant has not, since the date of the complainant's said letters-patent, sold or delivered to others to be used, cast-iron railroad car wheels, which, before their completion, have been subjected to the treatment or process described and specified in the said letters-patent, or to any treatment or process substantially or practically similar in its nature, and the same in its effects.

6. The cast-iron railroad car wheels made and sold, as aforesaid, by the defendant, and the wheels now in his possession, and being made by him, have not been taken from the moulds in which they were cast, before they had become so much cooled as to produce such inherent strain in any part as to impair its ultimate strength, and immediately after being thus taken from the moulds, deposited in a furnace or chamber substantially or practically previously heated, and so constructed of such material, and subject to such control, that the temperature of

all parts of the wheels deposited therein might be raised to the same point, when they were allowed to cool so fast, and no faster than was necessary for every part of each wheel to cool and shrink simultaneously together, and no one part before another, substantially as described in the complainant's letters-patent. On the contrary, the process that has been employed in the manufacture of the wheels so made and sold, and being made and sold, by the defendant, differs substantially from the process patented to the complainant as aforesaid, in the particulars as follows, to wit:

I. In the process of the complainant the wheels are placed, immediately upon being removed from the moulds, in a previously-
57 heated furnace, the temperature of which is equal to that of the wheels, while in the process used by the defendant the wheels are placed in a cold pit.

II. Immediately after the wheels are placed in the annealing furnace, in the process of the complainant, hot air is introduced into such furnace, and the temperature of all parts of each wheel is raised to a point a little below that at which fusion commences, as claimed by complainant, when all avenues to and from the annealing furnace are closed, and the entire mass left to cool by the heat permeating the walls of the furnace, and radiating from its outer surface; the object aimed at being, as stated in the complainant's letters-patent, to cause each part of each wheel to cool and shrink at one and the same time.

In the process employed by the defendant, on the contrary, the different parts of the wheels are not similarly or even approximately affected by the heat which is applied to them after they are placed in the annealing pit; nor is any part of the wheel or wheels reheated to a point at all approximating the point of fusion, if, indeed, the temperature be at all increased, which is not believed to be the case, or intended. During all the time that the wheels remain in the annealing pit, in defendant's process, the hubs are kept cooler than their plates by a current of cold air which passes through them, and the different parts of the several wheels do not simultaneously cool, and an effect is produced upon the wheels by defendant's process, which is different from the effect produced by the process of the complainant, as described in his said letters-patent.

7. The process practised and used by the defendant in the manufacture of car wheels is as follows: The wheels are taken red hot from the moulds in which cast, and are placed in an annealing pit with a layer of charcoal between each wheel, a layer of charcoal being laid on the uppermost wheel, and on this a metal plate is laid; the charcoal becoming now ignited by the hot wheels, the cover of the pit is then laid on, and a damper opened so as to admit just sufficient air to
58 effect the combustion of the contained charcoal in the space of about seventy-two hours; the draft of air so introduced passes downwards through the eyes or hubs of the wheels; on the top of the wheels is placed a lid or cover, and projecting above this and below it into the hubs of the wheels is a pipe for the purpose of conducting the current of air into the hubs of the wheels; in order that the combustion of the charcoal may be prolonged, in the bottom of the pit is also placed a perforated plate.

And further answering, the defendant states that, long prior to the date of the complainant's letters-patent, and of his alleged invention, the brittleness which is occasioned by the unequal contraction of metals when rapidly cooled was perfectly known and understood; and that long prior to the alleged invention of the complainant, glass and metals

which had been cast and formed in moulds, were, for the purpose of preventing brittleness and preserving the texture of the material, removed from the moulds in which cast, at a red heat, and immediately placed in previously heated furnaces or ovens, and there reheated to a high temperature, and then allowed to cool gradually, such process being termed "annealing."

And the defendant states that, in so far as the complainant in his said letters-patent claims to be the inventor of reheating car wheels after their removal from the moulds, or of a continuing process of removing them while at a red heat from the moulds, and without allowing them to cool, placing them in that state in a previously-heated furnace or chamber, and then reheating them to a high temperature, and then allowing them to cool gradually, such claim is beyond the invention of the complainant, and his said letters-patent void, for the reason that the same process was known and used long prior to such alleged invention by the complainant. And the complainant will take notice that the defendant at the trial of this cause, to show that the complainant was not the original inventor or discoverer of that which he has patented, will give evidence that such patented process was known to and used by the persons, and described in the printed publications as named and set forth in the following schedule, to wit:

59 Name.	Residence.	Used at—
Nathan Washburn	Worcester, Mass	Rochester, New York.
William Torrence	Green Island, Albany Co., New York	Glasgow, Scotland.
Elihu Smith	Albany, N. Y	Troy, New York.
Franklin Townsend	....do....do	Albany, New York.
Paul A. Sabbatton	....do....do	New York, New York.
Gilbert Weeks	....do....do	Matteawan, Dutchess Co., N. Y.
William Henry	Troy, New York	Pittsburg, Vermont, and Port Henry, Essex County, New York.
Benjamin Starbuck	....do....do	Troy, New York.
Joseph Neemes	Albany, New York	Albany, do
George W. Eddy	Waterford, N. Y	Waterford and Troy, N. Y.
Lyman Kinsley	Canton, Mass	Canton, Mass.
Seth Boyden	Newark, N. J	Newark, New Jersey.
Ross Winans	Baltimore, Md	Baltimore, Maryland.
William Wade	Pittsburg, Penn'a	Alger's Foundry, Bos., Mass., W. P. Foundry, N. Y., Pitts. Penn'a.
Joshua D. Howard	Boston, Mass	South Boston Foundry, or Alger's Foundry, Boston, Mass.
Hamilton Walker	....do....do	South Boston Foundry, or Alger's Foundry, Boston, Mass.
Gouveneur Kemble & Robert P. Parrott.	Cold Springs, opposite West Point, New York.	West Point Foundry, N. Y., and Pittsburg, Penn'a.
Stephen T. Newhall	Detroit, Mich	Milwaukee, Wis.
Geo. W. Beardsley	Albany, N. Y., and Little Falls, N. Y	Buffalo, N. Y., and Black Rock, New Jersey.
Geo. G. Lobdell	Wilmington, Del	Wilmington, Del.
Geo. S. Bosworth	Troy, New York	Syracuse and Troy, N. Y.
James Glass	....do....do	Syracuse and Troy, N. Y.

The Encyclopedia Britannica, or Dictionary of Arts, Sciences, and General Literature, (seventh edition,) with preliminary dissertations on the history of the sciences, and other extensive improvements and additions, including the late supplement, a general index, and numerous engravings, (volume III,) Adam and Charles Black, Edinburg, MDCCCXLII," in an article entitled "Annealing," on pages 196 and 197 of said volume of said public work; and in the same work, "volume X," an article entitled "Glass," on pages from 562 to 579, both inclusive, and particularly page 579 of said last volume of said public work; and in the same work, "volume XII," in an article entitled "Iron making," on page 435 of said last-named volume of said work.

60 The London Encyclopedia, or Universal Dictionary of Science, Art, Literature, and Practical Mechanics, comprising a popular view of the present state of knowledge, illustrated by numerous engravings and appropriate diagrams, * * * translation. By the original editor of the Encyclopedia, assisted by eminent professional and other gentlemen. In twenty-two volumes; vol. I, London: Printed for Thomas Tegg, 73 Cheapside; Charles C. Little and James Brown, Boston; Thomas Cowperthwaite & Co., Philadelphia, 1845." In an article entitled "Anneal, Annealing," on pages 341 and 342 of said volume of said last-named public work; and in the same work, "volume X," in an articled entitled "Glass," on pages from 222 to 237, both inclusive, and particularly page 237, of said last-named volume of said last-named work; and in the same work, "volume XX," in an article entitled "Speculum," on pages 757, 758, and 759 of said last-named volume of said last-named public work; and in the same work, "volume XXI," in an article entitled "Telescope," on pages 721, 722, and 723 of said last-named volume of said last-named public work; and in an article entitled "Steel," on pages from 189 to 193, both inclusive, of said last-named volume of said last-named work.

A Dictionary of Arts, Manufactures, and Mines, containing a clear exposition of their principles and practices. By Andrew Ure, M. D. * * Illustrated with twelve hundred and forty engravings in wood. From the second London edition, New York: Leroy Sunderland, 126 Fulton street, 1842." In an article entitled "Copper," on page 339 of said last-named public work; and in an article entitled "Glass making," on pages from 582 to 600, both inclusive, and particularly page 584 of said last-named public work; and in an article entitled "Steel," on pages from 1177 to 1182, both inclusive, of said last-named public work.

The Artists and Mechanic's Repository and Workingman's Informant, embracing chemistry, abstracts of electricity, galvanism, magnetism, mechanics, pneumatics, optics, and astronomy. * * * By
61 James Pilkington. Philadelphia: Published by Michael Kelley, No. 341 Market street, A. D. 1840. In an article entitled "Of iron," on page 281; and in an article entitled "Annealing," on page 281 and 282 of said last-named public work.

Turning and Mechanical Manipulation, intended as a work of general reference and practical instruction on the lathe and various mechanical pursuits followed by amateurs. By Charles Holtzapffel, associate of the institute of civil engineers, etc., to be comprised in five volumes; vol, 1, Materials; their differences, choice and preparation, various modes of working them generally, without cutting tools. Illustrated by upwards of 300 wood cuts. London: Published for the author by Holtzapffell & Co., 64 Charing Cross, and 127 Long Acre, A. D. 1843. In the foot on pages 371 and 372, commencing "In casting lead, tin," &c., and in note F, on page 462, commencing "The six-foot speculum," of said volume of said last-named public work.

The Cabinet Cyclopedia, conducted by the Rev. Dionesius Lardner, LL. D., assisted by eminent literary and scientific men—Useful Arts, a treatise on the progressive improvements and present state of the manufactures in metal. Vol. I, Iron and Steel. London: Printed for Longman, Rees, Drury, Brown and Green, Paternoster Row, and John Taylor, Upper Gower street, A. D. 1831. At pages 70, 73, 74, and 75, of chapter 4; and at pages 300 and 301 of chapter 19; and at pages 326 of chapter 20 of said volume of said last-named public work.

Journal of the Franklin Institute of the State of Pennsylvania, de-

voted to the mechanic arts, manufactures, general science, and the recording of American and other patented inventions. Edited by Thomas P. Jones, M. D. * * * Vol. 13. New series. Philadelphia: Published by the Franklin Institute at their hall; Thompson & Homans, Washington City; G. &. C. & H. Carville, New York; and Monroe & Francis, Boston. J. Harding, printer, A. D. 1834. In an article entitled "On the principles which determine the hardness of iron castings, and the mode of selecting the different varieties required by the
62 machinist," by Rufus Tyler, machinist, in No. 3, for March, A. D. 1834, at pages from 150 to 154, both inclusive; and in an article entitled "New method of softening iron," in No. 4. for April, A. D. 1834, at pages 218 and 219 of said volumes of said last-named public work.

The Franklin Journal and American Mechanics' Magazine, devoted to the mechanic arts, internal improvements, and general science, vol. I, 1826, in an article entitled "On iron and steel," by Tho's Gill, No. 4, "On the use of chilled cast iron for punches and other tools," in No. 4, for April, A. D. 1826, at pages 214, 225, and 226 of said volume of said last-named public work.

The Franklin Journal and American Mechanics' Magazine, devoted to the useful arts, internal improvements, and general science, under the patronage of the Franklin Institute, of the State of Pennsylvania. Edited by Dr. Tho's P. Jones, professor of mechanics in the institute. Vol. 4. Philadelphia: Published by Judah Dobson, No. 108 Chestnut street; Joseph Harding, printer, 1827. In an article entitled "On annealing cast iron, so as to make it as soft as iron," by Jacob Perkins, esq., at page 45 in the July number of said last-named public work.

An Encyclopedia of Civil Engineering, Historical, Theoretical and Practical, by Edward Cresy, architect and civil engineer; illustrated by upwards of three thousand engravings on wood, by R. Branston; in two volumes. Vol. 2, London, A. D. 1847. In an article entitled "Green or dry sand castings," in book 2d, chapter 2d, at page 689 of said volume of said last-named public work.

The Cyclopedia or Universal Dictionary of Arts, Science, and Literature, by Abraham Rees. * * * First American edition, revised, corrected, enlarged, and adapted to this country by several literary and scientific characters; in 41 volumes. Vol. XI. Philadelphia: Published by Sam'l F. Bradford and Murray, Fairman & Co.; Peter A. Mesier, New York, * * * and James W. Palmer, Lexington, Kentucky. In an article entitled "Cutlery," under the sub-head "Cutlery
63 made of pig iron," in the right-hand column of the left-hand page in said volume of said last-named public work, the same not being paged or dated, but having been published more than twenty years ago.

"Papers on Iron and Steel, Practical and Experimental," a series of original communications made to the Philosophical Magazine, chiefly of those subjects, with copious notes by David Musket. London: John Weale, 59 High Holborn, A. D. 1840. In an article entitled "On the various proportions of carbon which constitute the various qualities of crude iron and steel," at page 517 of said work.

"Philosophical Transactions of the Royal Society of London for the year MDCCCXL, Part 1. London: Printed by Richard & John E. Taylor, Red Lion Court, Fleet street, MDCCCXL." In an article entitled "On the reflecting telescope," on pages 503 to 527, both inclusive, and particularly at pages 510 and 511 of said work.

"The Engineers and Machinist's Assistant, being a series of plans,

sections, and elevations of steam engines, spinning machines, mills for grinding tools, &c., taken from machines of approved construction at present in operation, with descriptions and instructions for drawing machinery; also an introduction and essays on various departments of machinery. Blackie & Son. Queen street, Glasgow; South College street, Edinburg; and Warwick square, London, MDCCCXLVII." In an article entitled "Of tools," in part 2d, vol. I, page 161, right-hand column; in an article entitled "Of tools," in part 2d, vol. I, page 169, left-hand column, under the sub-head "Practical examples of hardening and tempering," in said last-named public work.

A Dictionary of Sciences, Literature, and Art, comprising the history, description, and scientific principles of every branch of human knowledge, with the derivation and definitions of all the terms in general use. Edited by W. T. Brunde, * * * assisted by Joseph Cauvin, esq.; the various departments by eminent literary and scientific men. 64 Illustrated by numerous engravings on wood. New York: Published by Harper & Brothers, 82 Cliff street, 1843. In an article entitled "Annealing," on page 54 of said last-named public work.

"Practical Essay on the Strength of Cast-iron and other Materials, containing practical rules, tables, and examples founded on a series of experiments, with an extension table of the properties of materials. By Thomas Tredgold. * * * The fourth edition, with notes, by Eaton Hodgkinson, F. R. S., to which are added experimental researches on the strength and other properties of cast-iron, with the development of new principles, calculations deduced from them, and inquiries applicable to rigid and tenacious bodies generally. By the editor. London: John Weale, 59 High Holborn, MDCCCXLII." In section I, Introduction, pages 8 to 11, both inclusive, of said last-named public work.

"The Record of Patent Inventions, containing an abstract of all specifications enrolled during each month, lists of all new patents granted, and law reports of patent cases, scientific notices, &c., with plates. By Mr. Alexander Prince, of the office for patents of inventions, No. 14 Lincoln's Inn Fields, October, 1842, to March, 1843, Vol. I. London: Printed and published by W. Lake, 170 Fleet street, and at the office for Patents of Inventions, Lincoln's Inn Fields; Sherwood, Gilbert & Piper, Paternoster Row; John Weale, High Holborn, and Herbert's Mechanical Library, Cheapside, 1843." On page 139 of said volume of said last-named public work, being the substance of the specifications of letters-patent granted to Sydney Jessop, of Sheffield, England, under the great seal of Great Britain, March 21st, 1842, for "An improved mode of preparing wrought iron intended for wheel-tires, rails, and certain other articles," said specifications having been enrolled September 21st, 1842.

"The American Artists' Manual, or Dictionary of Practical Knowledge in the Application of Philosophy to the Arts and Manufactures, selected from the most complete European system, with original improvements and appropriate engravings, adapted to the use of the 65 manufacturers of the United States. By James Catbush, in two volumes. Vol. I. Philadelphia: Published by Johnson & Warner and R. Fisher. W. Brown, printer, Church Alley, 1814." In an article entitled "Annealing," in said last-named public work, the same not being paged.

"A Dictionary of Arts and Sciences. By G. Gregory, D. D., * * * in three volumes, vol. 1, first American, from the second London edition, considerably improved and augmented. Published by S. Etheridge, jun., Charleston, and J. Pierce, Philadelphia, 1815. S. Etheridge, jun.,

printer." In an article entitled "Annealing or nealing," in said last-named public work, the same not being paged.

"A Dictionary of Mechanical Sciences, Arts, Manufactures, and Miscellaneous Knowledge, comprising the pure sciences of mathematics, geometry, arithmetic, algebra, &c., the mixed sciences of mechanics, hydrostatics, pneumatics, optics, and astronomy, experimental philosophy, the fine arts, agriculture and its implements, manufactures and their various processes, commerce and domestic economy, natural history, with biographical and historical notices of eminent men who have adorned science by their inventions and discoveries. Illustrated with many hundred engravings. By Alexander Jamieson, LL. D. London: Printed for Henry Fisher, Son & Co., Newgate street, 1827." In an article entitled "Annealing, nealing," on page 45 of said last-named public work.

"An American Dictionary of the English Language, intended to exhibit: I. The origin, affinities, and primary signification of English words, as far as they have been ascertained. II. The genuine autography and pronunciation of words according to general usage, or to just principles of analogy. III. Accurate and discriminating definitions, with numerous authorities and illustrations, to which are prefixed an introductory dissertation on the origin, history, and connection of the language of Western Asia and of Europe, and a concise grammar of the English language. By Noah Webster, LL. D. In two volumes, vol. 1. * * * New York: Published by S. Converse. Printed by
66 Hezekiah Howe, New Haven, 1828." In an article entitled "Anneal," in said volume of said last-named public work, the same not being paged; and also in an article entitled "Anneal," in volume 1 of an edition of said last-named work, published in 1840.

"A Directory of Chemistry and Mineralogy, with an account of the processes employed in many of the most important chemical manufactures, to which are added a description of chemical apparatus, and various useful tables of chemical weights and measures, &c., &c. * * * By A. and C. R. Aiken. Vol. I. London: Printed for John and Arthur Arch, Cornhill; and William Phillips, George Yard, Lombard street, 1807. W. Phillips, printer." In an article entitled "Anneal," on page 74; and in an article entitled "Copper—Alloys of," under the sub-head, "Copper with tin," on pages 347, 348, and 349 of said volume of said last-named public work.

"The Engineer's and Mechanic's Encyclopedia, comprehending practical illustrations of the machinery and processes employed in every description of manufacture of the British empire, with nearly 2,000 engravings. By Luke Herbert, civil engineer. * * In two volumes, vol. I. * * London: Thomas Kelly, 17 Paternoster Row, MDCCCXXXVII." In an article entitled "Annealing," on page 94 of said volume of said last-named public work.

"Encyclopedia, or a Dictionary of Arts, Sciences, and Miscellaneous Literature, constructed on a plan by which the different sciences and arts are digested into the form of distinct treatises or systems, comprehending the history, theory, and practice of each, according to the latest discoveries and improvements. * * * Compiled from the writings of the best authors in several languages, the most approved dictionaries, as well of general science as of its particular branches. * * The lectures of eminent professors on different sciences, and a variety of original materials, furnished by an extensive correspondence. The first
67 American edition, in eighteen volumes, greatly improved. Illustrated with five hundred and forty-two copper-plates. Philadelphia: Printed by Thomas Dobson, at the Stone House, No. 41 South

Second street, MDCCCVIII: In an article entitled "Glass manufacture," in volume vii, page 783, of said last-named public work.

CHA'S B. COLLIER,
Of Counsel for Defendant.

THE STATE OF , *County of* :

On this 14th day of June, A. D. 1866, came Albert L. Mowry, the defendant in the foregoing answer named, who, being duly sworn, says that, so far as the statements therein contained are within his own knowledge, they are true, and so far as they are derived from the information of others, he verily believes them to be true.

ALBERT L. MOWRY.

Sworn and subscribed before me this 14th day of June, A. D. 1866.

JOHN McLEAN, *Clerk.*

68 EXHIBIT A.

To all whom it may concern:

Be it known that I, A. L. Mowry, of the city of Cincinnati, in the county of Hamilton, and State of Ohio, have invented a new and improved mode of annealing car wheels; and I hereby declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying drawings, and letters of reference ma'ked thereon, which form part of this specification.

My invention consists in the use of charcoal or other equivalent substance, interlaid with the wheels in the annealing pits in connection with the regulated admission of air, for the purpose of heating the wheels up to a proper temperature, prolonging the heat, and permitting them to cool in the course of a given time gradually, as will be more particularly explained below.

In order that others duly skilled may be enabled to understand, and construct, and use my invention, I shall proceed to describe it in detail.

In the accompanying drawings, Figure 1 is a perspective view of two annealing pits and the necessary flues. Figure 2, is a vertical section through the same. Like letters of reference designate like parts in all the drawings.

A A are two annealing pits, which may be constructed of double metal shells *a a*, with concrete or other refractory material, *b*, between; or they may be merely built of brick. B is the horizontal flue communicating with inside of pits, by the perforated plate (in bottom of pit) *c c*. C is the vertical flue, or chimney shaft, which communicates with horizontal flue B, and may be of any convenient height. D is a cover provided to each pit; in the centre of cover is an opening, *d*, which
69 is closed by a damper, *e*; *w w* are car wheels built up in the pit, with charcoal between, and *f*, a perforated cast-iron plate laid on top of the topmost layer of charcoal, so as to distribute the air admitted equably through the fuel in the pit. The operation of my invention is as follows: A layer of charcoal having been laid on the perforated bottom *c* of the annealing pit, the wheels, as they are turned out of the moulds red hot, are placed in the pit, with a layer of charcoal between each wheel, a layer of charcoal being laid on the uppermost wheel, and on this a perforated metal plate is laid. The charcoal becoming now ignited by the hot wheels, the cover of pit is then laid on, and the damper opened so as to admit just sufficient air to effect the combustion

of the contained charcoal in the space of 72 hours, less or more, as may be found necessary for the annealing operation. The draft of air in the apparatus shown on drawings, is from above downward, but it may, without affecting my invention, be from below upwards, by conveying the air from the horizontal flue up through the pits, and through the aperture in cover, and from thence through flues into the main shaft or chimney *c*. The result will be the same in both cases, and the adoption of one or the other plan will be dictated by convenience.

It is well understood that chilled car wheels require to be cooled by a process which will permit the different parts to adjust themselves to each other, and accommodate the unequal contraction which results from the process of chilling. For this purpose, the wheels, while still hot, are sometimes placed in pits, and covered with dry sand, which causes them to retain their heat for a considerable time, and in slowly cooling, the adjustment above referred to takes place. In other cases, the wheels are placed in pits when they are heated by a furnace, and maintained at a high heat for several days. In other cases they are placed in pits, and a current of air is caused to pass through the centre eye of the wheel, which cools the hub more rapidly than the rim is cooled, thus reversing the process which takes place when the wheel is first cast in a mould with a chill surrounding the rim. All of these devises, and others
70 which it is not necessary to specify, are attended with difficulties, and with imperfections, which it is the design of my invention to obviate.

In the operation of my invention, it is found that the wheels, when removed from the annealing pit, are devoid of any strains from unequal contraction, and that they afford as much apparent resistance to fracture, as if they had been cast in an ordinary sand mould without the use of a chill.

I do not claim as my invention or any part thereof, the pits, flues, or currents of air, for the purpose herein described; but, what I claim as new, and desire to secure by letters-patent is: The employment of charcoal or other equivalent combustible substance, interlaid between the wheels in a pit, in a combination with an aperture, *d*, for regulating the supply of air to the same, so as to prolong the combustion of the fuel, and retain the heat for the purpose herein described.

A. L. MOWRY, *Inventor.*

Witnesses:
THO'S W. WITHENBUR.
W'M CLOUGH.

(Here follows diagram marked page 70.)

71 And afterwards, to wit, on the 25th day of January, in the year of our Lord one thousand eight hundred and sixty-seven, came the counsel herein, and filed in the clerk's office of said court a certain stipulation herein, which said stipulation is in the words and figures following, to wit:

United States circuit court, southern district of Ohio. In equity.

ASA WHITNEY
vs. } 534.
ALBERT L. MOWRY.

It is stipulated and agreed by and between the parties hereto that

the defendant may amend his answer, which is now done, and that the complainant may file his replication thereto, which is done accordingly.

SAM'L S. FISHER,
For Complainant.
CHA'S B. COLLIER,
For Defendant.

Which said amendment consists of the words and figures following, to wit:

72 And the defendant denies that the alleged invention of the complainant is useful; but, on the contrary, the defendant asserts that the process described and claimed in the said letters-patent is positively useless and injurious, inasmuch as the said process would ruin and destroy the hardness on the rim of the car wheels, known as the "chill," and thus greatly detract from the usefulness and durability of the wheels.

And afterwards, to wit, but on the same day, and in the year last aforesaid, came the complainant, by Henry Baldwin, jr., esq., his counsel, and filed in the clerk's office of said court his replication herein, which said replication is in the words and figures following, to wit:

United States circuit court, southern district of Ohio. In equity.

ASA WHITNEY
vs.
ALBERT L. MOWRY. } No. 534.

73 The replication of the above-named complainant to the amended answer of the above-named defendant.

This repliant, saving and reserving to himself, now and at all times hereafter, all and all manner of benefit and advantage of exception which may be had or taken to the manifold insufficiencies of said amended answer, for replication thereunto, say that he will aver, maintain, and prove his bill of complaint to be true, certain, and sufficient in law to be answered unto; and that the said answer of the said defendant is uncertain, untrue, and insufficient to be replied unto by these repliants without this, that any other matter or thing whatsoever in the said answer contained material or effectual in the law to be replied unto, and not herein and hereby well and sufficiently replied unto, confessed, and avoided, traversed or denied, is true; all which matters and things these repliants are and will be ready to aver, maintain, and prove, as this honorable court shall direct, and humbly pray, as in and by his said bill he has already prayed.

HENRY BALDWIN, JR.,
Sol'r and of Counsel for Complainant.

74 United States circuit court, southern district of Ohio.

ASA WHITNEY
vs.
ALBERT L. MOWRY. } 534.

It is stipulated and agreed, by and between the parties above named, that the appearance of the defendant shall be entered forthwith; that

the case shall be put at issue and prepared with reasonable despatch by both parties, in order to secure, if possible, a hearing during the next (April) term of the court; that the pending motion of the complainant for a preliminary injunction shall be continued until the fourth Wednesday of April, 1866, when, if not superseded by the final hearing, it shall be taken up without further notice; and further, that, if it be impossible to prepare the case for final hearing at the said April term, it shall be heard as soon thereafter as practicable.

SAMUEL S. FISHER,
Complainant's Solicitor.

75 CHA'S B. COLLIER,
For Defendant.

MARCH 31, 1866.

United States circuit court, southern district of Ohio.

ASA WHITNEY
vs. } 534.
ALBERT L. MOWRY.

With a view to expedite the preparation of this case, it is agreed that either party may take testimony before the filing of the answer, as if the issue were fully made up; it being understood that the substance of said answer will be a rehearsal of the state of the art and a denial of intringement.

SAMUEL S. FISHER,
Complainant's Solicitor.
CHA'S B. COLLIER,
Defendant's Solicitor.

CINCINNATI, *April* 12, 1866.

Deposition of a witness taken before me, Thornton M. Hinkle, special examiner, by consent of parties, on the 9th day of April, A. D. 1866, to be read in evidence on behalf of the complainant in a certain suit in equity pending in the circuit court of the United States for the southern district of Ohio, wherein Asa Whitney is complainant and Albert L. Mowry is defendant. S. S. Fisher appeared on behalf of complainant; Cha's B. Collier, on behalf of defendant.

GEORGE H. KNIGHT, of lawful age, being produced and sworn on behalf of complainant, deposeth and saith as follows, to wit:

Question 1. State your name, age, residence, and occupation.

Answer. George H. Knight; age, forty-six years; residence, Cincinnati, Ohio; am a consulting engineer and solicitor of patents.

76 Ques. 2. State your opportunities for acquaintance with theoretical or practical mechanics.

Ans. My business avocations for the past thirty years, have been as draughtsman and engineer, and for twenty-two years last past, as solicitor of patents, to examine, describe, and design improvements in the mechanic arts, including many pertaining to the manufacture of car wheels and other objects in cast iron. I have also been frequently examined in the capacity of an expert in patent cases, before the United States and other courts.

Ques. 3. State if you have examined letters-patent, No. 5531, granted

to Asa Whitney, April 25th, 1848, for an improvement in annealing and cooling cast-iron car wheels, and if yea, state if you understand the contents thereof, and whether the description in the specification is sufficiently clear and exact to enable those skilled in the art to make and use said improvement.

Ans. I have examined a certified copy of said patent, and believe I understand its contents. I regard the description in the specification as remarkably clear and exact, and sufficient for the purposes named in the question.

Ques. 4. State if you have examined and understand the mode of annealing cast-iron car wheels, used by the defendant at his manufactory in Cincinnati. If yea, describe said mode fully.

Ans. I have examined and believe I understand the mode of manufacturing cast-iron car wheels employed by A. L. Mowry, in his foundry at the corner of Lewis and East Front street, in this city. The mode practised in said foundry, I find to be substantially the same as that described in the patent of Asa Whitney aforesaid. As in said patent, the wheels are taken from their moulds as soon as they can be safely moved therefrom, and deposited in a furnace or chamber, which like that of Whitney, has a grated or perforated bottom for the reception of fuel, and the admission of draft. Instead of anthricite coal, however,
77 which Whitney recommends for use in his own locality, Philadelphia, on account of its cheapness, a bed of charcoal is laid upon the grate in Mowry's furnace, and upon this, the first car wheel, red hot from the mould being deposited, the said charcoal ignites; another layer of charcoal is thrown upon the wheel just inserted, which coal ignites on coming in contact with the wheel; upon this incandescent mass the next wheel is placed, and so on alternately, charcoal and wheel, until the entire batch of wheels has been deposited. The whole is then covered with a layer of charcoal of considerable thickness, and that with an iron plate having a central aperture; the furnace is then closed by an iron cover, also perforated at its centre. A small pipe is inserted through said perforation, and this rests by its lower end upon the plate before mentioned, the opening of the pipe and that of the plate coinciding; below the bottom grating is a flue, which communicates with a smoke-box having two doors, of which one communicates with the external air, and another with the foundry chimney, some sixty feet or more in height. In the accompanying sketch which I have prepared, (witness here produces sketch, marked "Complainant's Exhibit C," which is attached to this deposition,) "Exhibit C," before me, is an axial section, intended to represent approximately the furnace used by Mowry. "A" representing the batch of car wheels after insertion; *a a*^{1} representing two loops, to receive hooks by which the wheel is conveyed from the place of casting, and lowered into the furnace. B represents the wall of the furnace composed exterior*ally* of sheet-iron, and interior*ally* of fire brick. G is the ground surface. C is the grated bottom of the furnace. E is the flue which communicates with the smoke-box before spoken of. H is the cover of the furnace. I, the iron plate. G, the pipe resting thereon. After the insertion of the first wheel, and in fact immediately upon such insertion, the furnace starts in active operation, and all the wheels after the first are manifestly inserted in an already heated furnace. A slight difference in construction appears in
78 Mowry's furnace, apparently incident to the use of the more rapidly and intensely burning charcoal in place of anthracite coal. Were Mowry to start beforehand a fire of charcoal, the effect would be too quickly dissipated; and he, therefore, applies the fuel coincident

with or immediately preceding the insertion of the wheels. The intense activity of combustion of the particular fuel used by Mowry, has induced the addition to the furnace of an air-pipe, G. These features, however, appear to be merely appendatory, or additions. I find, in the furnace used by Mowry, all the essential features described by Whitney in his patent, to wit, a furnace or chamber, which, after the reception of the wheel, is adapted to be wholly or partially closed, at the discretion of the operator, and in which the wheels are capable of being raised, after insertion in the furnace, to any desired temperature short of that which would destroy the chill on the working surface of the wheel, and of being allowed to gradually cool by the radiation of heat from the entire mass.

Ques. 5. Please state the purpose and effect of the apparatus employed by Whitney and Mowry.

Ans. The purpose and effect is in both simply to anneal that part of the wheel situated within the chill, without materially impairing the latter. This result, Whitney discovered, he could accomplish, so as more perfectly to anneal the wheels without materially impairing the chill, by the use of external heat over and beyond the heat of the wheel, the previous mode of annealing the wheels having been to prolong the cooling of the wheels merely by heating sand or other slow conductor around them.

Ques. 6. State how far, in your opinion, the apparatus used by Mowry for annealing cast-iron car wheels, agrees in principle, mode of operation, and construction, with that patented to Whitney in said patent 5531.

Ans. I regard said apparatus of Mowry, in its principle, mode of operation, and construction, as substantially identical with that patented to Whitney.

79 Ques. 7. Look at "Exhibit C," and give the dimensions of the different parts, as far as you are able.

Ans. The furnace or chamber I estimated to be, by eye, about ten (10) feet to twelve feet deep, and of such interior diameter as will conveniently take in car wheels of the ordinary size, say about four feet. The aperture of the pipe G was about four (4) inches. A small annular space occurred between it and the edges of the aperture of the plate H. The furnace was sunk for about or nearly two-thirds of its length in the ground, above the surface of which it projected about four (4) feet. In the full furnace, the top of the plate I is about six or eight inches below the cover H. Twelve wheels were cast and pitted in one batch. The operator regulated or arrested the passage of draft through the instrumentality of the door, which I have before spoken of, communicating with the smoke-box and chimney. The time that elapsed between the insertion of the wheels and their removal from the furnace, I was informed, was about four days.

Complainant offers in evidence certified copy of letters-patent of the United States, number 5531, granted to Asa Whitney, for an improvement in annealing and cooling cast-iron car wheels, April 25, 1848, marked "Complainant's Exhibit A." Also, certified copy of the certificate of the extension of said last-mentioned patent, for seven years from the 25th day of April, 1862, marked "Complainant's Exhibit B."

Also, the drawing produced by the witness, marked "Complainant's Exhibit C."

Cross-examined:

Ques. 1. If two pieces of iron of different thickness are subjected for a given time to the same heat, will they be raised to the same tempera-

ture, or will the thinner piece exhibit a greater degree of heat than the other?

Ans. It depends on the length of time. The thinner piece will become first heated, however, and be the first to cool.

80 Ques. 2. If all parts of a car wheel are subjected to the same degree of heat, will they be similarly effected by it, or will the thin parts be raised to a greater degree than the thicker parts?

Ans. As I said before, the thin parts will be the most quickly heated. All parts will become equally heated by a sufficient duration of contact with the heating medium.

Ques. 3. Is it desirable, in your opinion, that all parts of a car wheel, in the process of annealing, should be heated to the same degree?

Ans. If the heat is not excessive, or too abrupt in its action, I should not anticipate any bad effects from an equal application of heat at all parts.

Ques. 4. What would you call an excessive heat?

Ans. I would call a heat excessive which tended to fuse, or too rapidly expand the thinner portions, or which tended to destroy or impair the chill, where there was any. The exact temperature which could be reached with safety, I am not able to state.

Ques. 5. Is it desirable, in your opinion, that all parts of a wheel, in the process of annealing, should simultaneously cool?

Ans. That is my opinion.

Ques. 6. If all parts of a wheel are heated to the same temperature, will its parts simultaneously cool?

Ans. Not absolutely so, but if the cooling process be sufficiently protracted, the cooling will be so nearly simultaneous and equable as to present no appreciable difference.

Ques. 7. Is your opinion in this particular based upon experiment or observation?

Ans. Upon observation, chiefly.

Ques. 8. Where did you observe such effect or result?

Ans. I have observed it in numerous examinations of the fracture of iron under different circumstances. I am not now, however, able to give any particular locality.

81 Ques. 9. Can you tell from the fracture of a piece of iron of unequal thickness, which has been heated, whether its several parts were simultaneously cooled? If so, how can you tell?

Ans. If the several parts have been simultaneously cooled, the surface of the fracture will present a uniform grain and color. If unequally, the parts which have been cooled most quickly will present a brighter and more crystalline fracture.

Ques. 10. If you insert a piece of iron which is three inches thick at one end, and one inch thick at the other, into a furnace, will its extremes be simultaneously and equally heated, in a practical sense?

Ans. It would depend entirely on the heat of the furnace. If the heat were not too extreme, the difference in rapidity of heating of the thicker and thinner portions would not be material, in a practical point of view.

Ques. 11. You state that, in your judgment, the letters-patent of Mr. Whitney are sufficiently clear to enable any one skilled in the art to carry into practical effect his invention. Having read the letters, will you now state precisely what you would do if called upon to anneal wheels in the city of Cincinnati, according to those letters?

Ans. I think my course of action would be determined by the nature of the fuel of a suitable character within my reach. Anthracite coal

being unobtainable in any quantity in this locality, and bituminous coal, from the amount of sulphur contained in it, being unsuitable, I should be led to look for some other fuel. Wood charcoal, although costly and of rapid combustion, I should probably be led to select, and if using it, would find it necessary to employ it much in the same manner as done by Mowry. I do not assume that the spec'fic details I should resort to would be identically the same.

Ques. 12. In the letters-patent of Mr. Whitney, after stating that he takes the wheels from the moulds, he says as follows: "I put them in this state into a furnace or chamber that has been previously
82 heated to a temperature as high as that of the wheels when taken from the moulds." In the process used by Mr. Mowry, is not the pit cold when the wheels are placed in it?

Ans. Before the insertion of the first wheel, the pit is or may be cold. Before the insertion of all the subsequent wheels the pit is heated by the combustion going on within it, the wheels being surrounded by flame and incandescent masses of charcoal, to a high degree of heat.

[Adjourned until Tuesday, April 10th, 1866, at 11 o'clock, a. m.]

TUESDAY, *April 10th*—11 *o'clock, a. m.*

Ques. 13. How long does it take to remove all the wheels from the moulds and place them in the pit at Mowry's establishment?

Ans. I do not know.

Ques. 14. Can you approximate to the time?

Ans. I have only seen them being placed in the pit. My impression is, it consumed about five minutes to deposit each wheel and its accompanying charcoal.

Ques. 15. When the wheels are placed in the pit, do they at first receive or part with heat?

Ans. Their first effect is to part with a portion of their heat. I will explain more in full what I mean. The first wheel inserted continues to part with its heat to the surrounding air and to the charcoal, until it has ignited the latter; the wheels subsequently inserted part with a portion of their heat to the surrounding air and continue so to do until they approach the burning mass.

Ques. 16. In Whitney's process, upon the supposition that the pit, before the wheels are inserted in it, has been previously heated to a temperature as high as that of the wheels when taken from the moulds, do they, when inserted, part with any of their heat?

Ans. I think not.

83 Ques. 17. Does not Mr. Whitney, in his patented process, heat his wheels, after they are inserted in the pit, by hot air, conducted from a furnace which is separate from a pit?

Ans. In the form of pit selected by Whitney to illustrate his invention, the fire-place for his fuel occupies the bottom of the pit itself. He, however, states that the heat required to perform the process, may be obtained by the use of any other fuel that may be less expensive, at the place where the process is to be performed, or the requisite heat may be taken in a suitable conduit from the furnace in which the metal is melted.

Ques. 18. In your examination-in-chief, you state that Mr. Whitney recommends the use of anthracite coal, because of its cheapness in his locality. You further say, "On account of its cheapness, a bed of charcoal is laid upon the grate in Mowry's furnace;" do you mean to be understood as saying that Mowry uses charcoal because of its cheapness?

Ans. No. My remarks, commencing "A bed of charcoal," were intended for a new sentence.

Ques. 19. Suppose you constructed in this city an annealing pit, similar to that described by Mr. Whitney in his letters-patent, could it be used with the fuel of this locality to advantage?

Ans. I suppose the only fuel obtainable in this locality of a suitable character, where it was intended to build the fire beforehand, as in Whitney's illustration, would be coke.

Ques. 20. Why could not bituminous coal be used to advantage?

Ans. It might be used, I presume, if allowed to burn a sufficient length of time before the insertion of the wheels, to get rid of the sulphur.

Ques. 21. Would not, in your opinion, the waste of fuel necessary, in order to get rid of the sulphur, counterbalance the advantages derived from the use of the annealing process, or render it too expensive?

Ans. That would probably be the case.

84 Ques. 22. What, in your opinion, would be the effect if anthracite coal was interlaid between the wheels, in Mowry's process, instead of charcoal?

Ans. From the sluggish character of the combustible, the first effect would be to cool down the wheels and retard the annealing process. I think, also, that the contact of freshly kindled anthracite would have some of the injurious effects of bituminous coal, under the like circumstances, from the presence of sulphur.

Ques. 23. Has not the contact for burning charcoal with iron an advantageous chemical effect upon the iron in annealing?

Ans. With wrought iron, it has the effect of making it approximate to the character of steel. With cast iron, its effect will vary. If the iron is not completely saturated with carbon, and a sufficient heat be used, accompanied by the exclusion of air, the iron may be made to take up a portion of carbon, but the result will be to remove it still farther from the condition of wrought iron. I do not see how it could be made to add to its malleability.

Ques. 24. Do you know whether the effect of the two processes of Whitney and Mowry is the same upon wheels. If so, how do you know it?

Ans. I do not, having no experiments or observations upon the subject.

Ques. 25. If, from observation or experiment, you ascertained that a wheel, treated according to Mowry's process, was stronger and more durable than the one treated according to Whitney's process, would it not be your opinion that the processes themselves were different?

Ans. I should attribute such superiority, if found to exist, to some superiority in the materials, either of the wheels or fuel.

Ques. 26. If you attributed it to the fuel used by Mowry, would not that, in fact, be attributing it to a different process from Whitney's?

85 Ans. I think not. Whitney, in his patent, states that other fuel than anthracite may be employed, and wood charcoal, where not too expensive, has always been the preferred material over stone coal for most operations in iron.

Ques. 27. Do you know the process of annealing car wheels, in use anterior to Whitney's invention?

Ans. I know of the use, anterior to his invention, of sand, for the purpose of retaining the heat of the castings, and permitting the crystallization to proceed slowly.

Ques. 28. State just how such process was used.

Ans. One way was to envelop the wheels, as they lay in their moulds. I think this was the mode generally resorted to, to the best of my recollection. Another mode, however, was, immediately after removing them from their moulds, to cover them with sand or loam. The purpose, in both cases, being to prolong the process of cooling.

Ques. 29. Will you please state how long prior to Whitney's invention, and where, you knew of the use of either process last described by you?

Ans. Such annealing process has been known in metallurgic operations for a long time—some centuries, I suppose. I do not at this moment call to mind any particular locality.

Ques. 30. In referring to these processes in use anterior to Whitney, for annealing wheels, do you intend thereby to state the history of the art?

Ans. I state it as pertaining to said history.

GEO. H. KNIGHT.

86 I, Thornton M. Hinkle, do hereby certify that the foregoing deposition was taken before me, special examiner appointed in this case, wherein Asa Whitney is complainant and Albert L. Mowry is defendant, commenced on the 9th day of April, A. D. 1866, and adjourned to and concluded on the 10th day of April, A. D. 1866; that the said Knight was first duly sworn to tell the truth, the whole truth, and nothing but the truth; that the deposition was reduced to writing by me in the presence of the witness, and by him subscribed and sworn to before me.

THORNTON M. HINKLE,
Special Examiner.

87 United States circuit court, southern district of Ohio. In equity.

ASA WHITNEY
ag'st
ALBERT L. MOWRY. } No. 534.

SIR: Please take notice that, on Thursday, the 26th day of July inst., at 10 o'clock a. m., I shall proceed to take testimony, and examine witnesses in the above-entitled suit, on the part and in the behalf of the complainant, at my office, No. 36 South Seventh street, in this city, before Charles Sergeant, esq., a special examiner duly appointed in this cause; said examination will continue from day to day, pursuant to adjournment, until completed.

HENRY BALDWIN, JR.,
Compl't's Solicitor

To GEN'L H. L. BURNETT,
Def't's Sol'r, Continental Hotel, Phila.

Service of a copy of the above notice acknowledged this 20th day of July, A. D. 1866.

H. L. BURNETT,
Of Counsel for Def'd't.

Depositions of witnesses taken before me, Charles Sergeant, special examiner named in foregoing notice, in pursuance of said notice, in the above-entitled cause, at the place named in said notice, at the time hereinafter specified, and from time to time as adjourned; to be read in evidence on behalf of the complainant, in a certain suit in equity pending in the circuit court of the United States for the southern district of Ohio, wherein Asa Whitney is complainant, and Albert L. Mowry is defendant.

Henry Baldwin, jr., esquire, appeared on behalf of complainant.
General H. L. Burnett appeared on behalf of defendant.

88 By agreement of counsel, the examination noticed for *the* Thursday, the 26th day of July, 1866, having been adjourned to this 30th day of July, 1866, and the parties then appearing, the complainant by his counsel, Henry Baldwin, jr., and the defendant by his counsel, Gen'l H. L. Burnett, before me, Charles Sergeant, a special examiner duly appointed in this case, COLEMAN SELLERS, a witness produced on the part of complainant, being duly sworn, doth depose and say:

Question 1. What is your name, age, residence, and occupation?

Answer. Coleman Sellers; I am thirty-nine years of age; I reside 3301 Baring street, Philadelphia. I am a mechanical engineer.

(It is agreed that printed copies of the bill, answer, and patents of complainant and defendant may be used in taking testimony in this case by either party, the same and with the same effect as if such printed copies were duly authenticated—this stipulation extending to the deposition of George H. Knight.)

Q. 2. Are you familiar with the manufacture of iron, and particularly with the manufacture of railroad car wheels? and if yea, please state the character and extent of such familiarity.

A. I have been acquainted with the manufacture of car wheels for a period of sixteen years, being at the beginning of that time engaged in locomotive building, afterwards as foreman in the locomotive shops of Niles & Co., of Cincinnati. For ten years I have been quite familiar with the process patented by Mr. Whitney.

Q. 3. Have you read, and do you understand the process of manufacturing car wheels described and specified in the letters-patent, a copy of which is now shown you, numbered 5531, and granted to Asa Whitney April 25th, 1848?

A. Yes, I have read the patent, and understand it.

89 Q. Have you read, and do you understand the defendant's process of manufacturing car wheels, described in the deposition of George H. Knight, taken in this case, and a copy of which is now shown you?

(Question objected to.)

A. I have read it, and understand it.

Q. 5. Have you read, and do you understand the letters-patent granted to A. L. Mowry, for a new and improved mode of annealing car wheels, a copy of which is now shown you, said letters-patent bearing date May 7th, 1861?

A. I have, and do understand it.

Q. 6. Does the process of manufacturing car wheels, described in said Knight's deposition as being practiced by the defendant, or as described in said patent, embody the process described in the said patent of the complainant? and if you answer yea, please give your reasons for the conclusion you may express. Answer fully.

(Objected to.)

A. I think that the processes are the same. In Mr. Whitney's process, the wheels, while still at a red heat, are removed from their moulds and placed in a pit prepared for their reception, and there subjected to such a degree of heat as shall equalize the strains produced by the unequal cooling of the casting in the mould; after which, the pit, being closed, is allowed to gradually cool with its charge of wheels—this slow cooling process allowing all parts of the wheels to gradually contract, without any unequal strain in any part of the said wheels. In Mr. Mowry's process, as understood by me, the wheels are taken from the moulds at a red heat, the same as in Mr. Whitney's process; while still red-hot are placed in a pit essentially the same as that used by Mr. Whitney, then subjected to a degree of heat for the same purpose as in Mr. Whitney's process; after which they are cooled by the same slow passage of the heat through the walls of the pit, as in Mr. Whit-
90 ney's process, this cooling process occupying about the same time in either process. In the process of Mr. Whitney, the pit used is previously heated by a fire of anthracite coal; into this the wheels are placed, the heat being increased at the discretion of the man in charge of the furnace which gives the heat to the pit. In Mr. Mowry's process, the pit has a layer of charcoal at its bottom, upon which the first red-hot wheel is placed; some more charcoal scattered over the surface of this wheel; then a second wheel is placed on the top of the first wheel; more charcoal added; thus the pit is filled up by alternate layers of charcoal and wheels. The charcoal being very easily ignited, bursts into flame at the contact with it of the first wheel. Thus each successive wheel enters a heated atmosphere as in Mr. Whitney's case, sufficient, I think, to prevent any further cooling of the wheels. When the pit is full, a cover is placed on the top, through a hole in which air can be admitted to the burning charcoal, and the cumbustion of the charcoal regulated, at the discretion of the man in charge of the pit. Thus in both cases, there is an equalizing of the strains by this after-heating in the pit; and the slow cooling of the pits in both cases must bring the wheels, when cold, to nearly the same condition.

Q. 7. In speaking of the wheels, after being placed in the pit prepared for their reception, being subjected to such a degree of heat as shall equalize the strains produced by the unequal cooling of the casting in the mould, what degree of heat do you indicate, relative to the temperature of the wheel when removed from the mould?

A. If the wheel be reheated until all parts of the wheel be of the same temperature as the hottest part of the wheel, at the time of its removal from the mould, and provided the wheels be removed from the moulds at as high a degree of temperature as is consistent with their safe removal, the strains incident to irregular cooling in the mould, I think, would be in a great measure equalized.

91 Q. 8. Please specify the differences, if any, that you find between the processes described in said Knight's deposition, or in said Mowry's patent, and the process specified in the complainant's patent. Answer fully.

A. The only difference that I see is in the manner of heating the pits, into which the wheels are placed. In Mr. Whitney's process, he uses anthracite coal for the purpose of heating the pit. He lights the fire sometime before the insertion of the wheels, in order to prevent the red-hot wheels from cooling down during the time of filling the pit. In Mr. Mowry's process this lighting the fires previously to the insertion of the first wheel seems needless, as the ready combustion of the fuel used fills the cold pit with a heated atmosphere sufficient to subserve the purpose

of Mr. Whitney's previous ignition of the fire. The amount of charcoal placed in the furnace in Mr. Mowry's process, and the slowness of the admission of air to this charcoal, determines the amount and duration of the reheating part of the process, while in Mr. Whitney's it can be continued or discontinued (I mean the after-heating) at the option of the furnace tender; thus, *is* my opinion, being more controllable than in the charcoal process, as practiced by Mr. Mowry.

Q. 9. Please specify the means, if any, for controlling the admission of air, or regulating the combustion of the fuel in the defendant's process, as described in his patent or in said Knight's deposition.

(Objected to by counsel for defence.)

A. In Mr. Knight's deposition, I understand him to say that at the center of the bottom of the pit, as used in Mr. Mowry's process, there is a hole communicating with a flue, and thus to a chimney; this hole corresponding in position to the center eye of the first wheel to be placed therein. The first wheel, when put in place, has a temporary stopper lowered into its eye to prevent the charcoal, when being scattered over the surface of the wheel, falling in and clogging this hole.

92 This stopper is removed previous to the placing of the second wheel, (the eye of which is made to coincide, or nearly so, with the eye of the first wheel;) thus by the alternate stopping up of the eye at each successive charge, and its opening for the reception of the next wheel, the pit, when full of wheels and layers of burning charcoal, has a clear opening from top to bottom of the pile, through the eyes. Upon the top of the top wheel is placed a pipe, corresponding also with this air passage through the eyes; this pipe having a flange near to the surface of the upper wheel, extending outward so as to cover, or nearly cover, the upper surface of the top wheel. The pipe continues or is extended upwards above the rim of the pit. A cover placed on the pit has a central opening through which this pipe passes, this central opening being larger than the external diameter of the pipe, thus forming an annular space around said pipe. Air can pass down through this pipe and through the eyes of the wheels, provided the hubs of the wheels are in absolute contact, and forming by this contact a tight series of joints from top to bottom. The plate upon which the bottom wheel rests is perforated with a number of holes, and below this plate a passage is formed, communicating with the chimney. Air, to supply the combustion, passes in at the top of the pit, through the annular passage or space in the top cover, around the central pipe. Theoretically, cold air can be made to pass down the central pipe, provided the draught of the chimney is sufficient to counterbalance the ascending heated current, engendered within the eyes of the wheels and pipes by the heat of the wheels and the layers of fuel. Such cold air might reach and modify the temperature of the hub of the upper wheel, but I do not think that it could affect the temperature of any others of the pile; nor do I think, from the description of the process as described by Mr. Knight, and from the obvious irregularities incident to the process of moulding in each hub, these irregularities preventing the wheels from coming in contact and forming a tight joint at each hub, that the central pipe serves any other purpose than an additional chimney placed in the centre of the furnace. Air to regulate or to supply combustion,

93 passing in at the upper part of the furnace and downward through the fuel, is regulated by a door communicating with a passage below the pit into the chimney.

Q. 10. What would be the effect upon the combustion of the fuel if the door you have last mentioned were entirely closed?

A. I understand that the purpose of the door above alluded to is to regulate the draft of the furnace—the closing of this door diminishing the draft, and the opening of it increasing the draft. The closing in such case would have the effect of lengthening the duration of the combustion, and decreasing its intensity.

Q. 11. Do you find any other differences between the processes of Mr. Whitney and Mr. Mowry than those you have mentioned?

A. I do not find any other difference.

Q. 12. In your opinion, are the differences you have mentioned substantial, or merely formal?

A. They are merely formal.

Q. 13. Are you the same Coleman Sellers who made an affidavit in this case March 19th, 1866, or thereabouts?

A. I am.

Q. 14. Please name any cases, if any there be, in which you have testified in respect to patents as an expert.

A. I have several times been called upon to testify as an expert. I have frequently been called upon to give opinions in regard to the similarity or dissimilarity of conflicting patents. In my position as mechanical engineer for William Sellers & Co., the comparison and determination as to conflicting patents has been my special business for ten years.

Q. 15. Do you occupy any position in any scientific association, or in connection with scientific publications in this country or elsewhere?

A. I am a director of the Franklin Institute, and have been so for a number of years; and was previously a director in the
94 Mechanics' Institute of Cincinnati. Am a member of the principal scientific committes of the Franklin Institute, and am usually chairman of the sub-committees on science and art, detailed for the examination of certain classes of mechanical inventions; am president of the Philadelphia Photographic Society; have written for many of the American scientific journals, being a solicited contributor to Silliman's, and also to foreign journals.

Cross-examined by H. L. Burnett, esq.:

Question 1. Please state whether you have any knowledge of Mr. Mowry's process under his patent other than that obtained from the patent itself, and the deposition of Mr. Knight, referred to by you.

Answer. I have had a description of the process given to me by Mr. Corey, of Niles' Works, of Cincinnati. On a recent visit to Philadelphia he described to me, at length, Mr. Mowry's process. I have no personal knowledge of the process. I have never seen it.

Q. 2. I understand you to say that you have given special attention, and been employed as an expert in the examination of patents, for the purpose of testifying in court, or rendering opinions as to whether there were conflict in said patents or not, for about ten years. Is that correct?

A. For ten years for the firm of William Sellers & Co. During that ten years, for other persons than William Sellers & Co. And for ten years previous to that, while residing in Cincinnati, I had many times to give opinions in such cases, but not in court, except in one instance, in Cincinnati.

Q. 3. Have you made such an investigation in this case as enables you to give the history of the art of *the* annealing castings, and exactly what in Mr. Whitney's patent is new and patentable, and what therein described was known prior to the issuing of the patent, April 25th, 1848?

A. I think I am familliar with the general history of the art,
95 and believe that I know what was new and patentable at the time of Mr. Whitney's application. My general familiarity with the business, and knowledge of the difficulties to be overcome, has given me the information during a period of many years.

Q. 4. Please state, then, in your opinion, whether the art or process of annealing castings, making them stronger and more durable by prolonging the time of cooling, is new or old; and if old, what the mode used prior to the patent of Mr. Whitney was.

(Objected to as not a cross-examination. The question of novelty not having been touched in the examination-in-chief, and complainant's counsel gives notice to the defendant's counsel, that if he insists upon an answer to this question, the witness will be treated as a witness for the defendant, and plaintiff's counsel will claim the advantage thereof. Defendant's counsel claims it to be a perfectly legitimate cross-examination of complainant's witness, and insists upon an answer to his question.)

A. The advantage to be derived from prolonged cooling was known previous to the application of Mr. Whitney, so far as is still customary in all founding operations; as, for instance, covering up with sand or other non-conducting material; and in some cases, moulds have been enclosed in cases, to prevent the too rapid passing off of the heat; but in all casting operations, where the form to be made is very irregular, even such prolonged cooling fails to remove the strains incident to such cooling—the cooling of each separate part proceeding pro rata with its first cooling action. To compensate for this it was usual, previous to Mr. Whitney's invention, and is still practised, to uncover certain portions of the mould, and thus hasten the cooling of that part, while other portions of the castings were kept hot by being surrounded by non-conducting materials.

Q. 5. Do I understand you to say, then, that this mode just described by you of annealing, was the only one known to the art at the time of Mr. Whitney's application for his patent, and that previous
96 thereto, that castings had not been taken in a red-hot state, or while still at a very high degree of temperature, from the moulds, and placed in a previously heated chamber, oven, or pit, and then allowed to cool slowly, or the time of cooling prolonged; or that previous to the issuing of this patent, castings had not been taken at a high state of heat from the moulds, and placed in an oven, chamber, or pit, and by the application of heat, the time of cooling prolonged?

(Objected to by complainant's counsel: First. As too general; as prior use or knowledge of an invention can only be proved in a suit at law, under due specific notice, as required by the statute, or in a suit in equity, by such due notice given in the answer, the same as required in a suit at law. Second. As not proper in a cross-examination, the subject not having been alluded to in the direct examination. Third. Because on the examination-in-chief it is leading, and if the counsel for defendant insists upon an answer, complainant's counsel will treat the witness as a witness for defendant, and will insist upon his rights and advantages, as if the witness had been re-called by the defendant.

It is claimed by the counsel for the defense that the question is competent: First. For the purpose of testing the competency of the witness as an expert, extent of investigation, value and force of the testimony given by the witness in his examination-in-chief.

Second. The witness having testified that there was a conflict in the patents of Mr. Whitney and Mr. Mowry, and that Mr. Mowry's process

was an infringement of Mr. Whitney's, it is desired and claimed to be perfectly competent and legitimate to ascertain from the witness, where, in his opinion, in the process described in Mr. Whitney's patent his rights begin, and where the conflict or infringement first commences. Defendant's counsel therefore insists upon his question.

Complainant's counsel replies that witness has not stated that there is any conflict between the two patents; that the construction of the patents is matter of law; that this cross-examination is directed
97 without any foundation being laid therefor to the state of the art, at the date of Mr. Whitney's application for a patent—the date of such application not appearing in the case; but to prevent the witness being mislead as to date, complainant's counsel here puts in evidence a certified copy of the file wrapper and contents, (from the U. S. Patent Office,) in the matter of application of said complainant for the patent granted to him, April 25, 1848, and the same is marked by the commissioner "Complainant's Exhibit C.")

A. It was not the only mode of annealing castings known at the time specified; at the time of his application, cold castings of metal had been reheated for the purpose of annealing or softening; castings, other than metal, had been treated by removing in a red-hot condition from the mould, and placed in a previously heated furnace for the purpose of annealing, but such practice was not, to my knowledge, used in castings of metal. I do not know of any case prior to the time specified, (the date of Mr. Whitney's application,) in which castings of metal were taken in a red-hot condition, or at a high heat, and placed in a previously-heated chamber, oven or pit, for the purpose of equalizing the strains in the various parts of the castings, incident to irregular cooling in the mould, nor for the purpose of prolonging the cooling.

Q. 6. In your opinion, then, is that part of Mr. Whitney's process of taking the castings at a red heat from the moulds, and placing them in a previously-heated chamber or pit, for the purpose of prolonging the time of cooling, simply new?

A. I do not think that that in itself is a novelty, irrespective of the temperature to which the pit has been previously heated.

Q. 7. In your opinion, is the kind of furnace or pit in which the wheels are placed, used in Mr. Whitney's process, a novelty, and covered by his patent?

(Objected to as a question of law, calling for the construction of patents.)

98 A. The particular form of the pit, as described by Mr. Whitney in his patent, is one adapted to the work to be done, and differs in no essential from other furnaces previously used for the purpose of heating their enclosed contents. I mean previous to his patent.

Q. 8. Then I understand you to say, that the particular kind of furnace or pit used by Mr. Whitney, is not new or essentially different from those used for the purpose of annealing castings, prior to Mr. Whitney's patent?

A. It is different in its form, but not in its essential features, from furnaces used for annealing; annealing castings, other than to render them softer or more ductile, not being in general use at that time, but it is the form of furnace which would suggest itself for the purpose of annealing similar shaped castings, provided it were desirable so to do.

Q. 9. In answer to the question of the complainant, "Does the process of manufacturing car wheels, described in said Knight's deposition, as being practised by the defendant, or as described in said patent, embody

the process described in the said patent of the complainant?" you have said, "I think that the processes are the same." Do you mean to be understood by this answer, that the process described in the patent of the defendant is embodied in the patent of the complainant? as that is the question, and your answer is not quite clear.

A. I do mean, that the process as described in the patent of the defendant, is covered by the patent of the complainant, the processes as described in each, covering the same theory, mode of operation, and effect.

Q. 10. Then your testimony upon this subject is based upon your reading, and construction of the two patents, is it not?

A. It is.

Q. 11. In your testimony-in-chief you say, the processes are the same. In Mr. Whitney's process, the wheel in a red-hot state, is placed in a previously-heated chamber, is it not?

A. It is.

99 Q. 12. Mr. Mowry commences his process by depositing wheels in a cold chamber, does he not?

A. He does, so far as the lowering of the wheel into the pit, which is but a continuation of the conducting of the red-hot wheel to its resting place in the pit; but when it reaches the bottom of the pit, and comes in contact with the charcoal, it is in essentially the same heated atmosphere as in Mr. Whitney's previously heated furnace, although Mr. Mowry does not ignite his fuel by other source of heat than the wheel itself previous to the insertion of the first wheel.

Q. 13. You mean to say, then, that Mr. Mowry's wheel, after the lowering of this first wheel, as you just have said, "is in essentially the same heated atmosphere as in Mr. Whitney's previously-heated furnace?"

A. I do mean to say that it is in the same condition so far as concerns the heat of that particular wheel. In Mr. Whitney's previously-heated furnace the wheels do not cool down; or in other words they are kept hot by the heat of the furnace, while in Mr. Mowry's case the first wheel is kept hot by a fire of its own making.

Q. 14. In Mr. Whitney's process, the first wheel is deposited in a furnace or chamber previously heated to a temperature as high as that of the wheels when taken from the moulds, is it not, as described in his patent?

A. It is so described in his patent, and in practice the furnace has been so previously heated; but whether it be of the temperature of the wheel at the time they are taken from the moulds, I am not able to say definitely, as comparisons of heat under such circumstances are very difficult, but I do know that the wheels, when placed in Mr. Whitney's previously-heated pit, do not sensibly cool down, and should infer that the heat used or attained previous to the insertion of the wheels was about the temperature of the wheel when taken from the mould.

Q. 15. Do you mean to say, then, that Mr. Whitney does or does not follow the process described in the patent and in the words of
100 his patent, that he "places his wheel in a chamber or furnace that has been previously heated to a temperature as high as the wheels when taken from the moulds?"

(Question objected to as having been already asked and answered.)

A. I think Mr. Whitney does follow the process essentially as described in his patent, and does place his wheels in a furnace or chamber previously heated to the degree indicated in his patent. But I answer this in connection with my previous answer, in which I give my reasons.

Q. 16. Then you were correct when you said that Mr. Mowry's first wheel, when first lowered into the pit, is in essentially the same heated atmosphere as Mr. Whitney's previously-heated furnace, so far as that one wheel is concerned. Is that your answer?

A. I was correct in so saying, and believe that the wheel, when deposited—by which I mean has ceased to be in transit from mould to pit—is in essentially the same heated atmosphere.

Q. 17. Then you say that one wheel lowered into this cold chamber or furnace of Mr. Mowry's would raise the atmosphere of that furnace by the ignition of the charcoal to such a degree as to be essentially the same as in Mr. Whitney's furnace, which you have said is the same heat as the wheels when taken from the moulds?

A. I did not say, nor do I believe, that the temperature of the furnace will be raised (that is, of the whole and entire furnace) to the same temperature as is Mr. Whitney's, but I did say, and do now affirm, that the red-hot wheel, when placed on the bed of charcoal in the cold furnace of Mr. Mowry will be enveloped in a heated atmosphere as great or of as high a temperature as it would have been if placed in Mr. Whitney's previously-heated furnace; and that, if a red-hot car wheel be laid on charcoal which shall be ignited by the said wheel, so that the flames shall envelope the wheel, as I believe they do
101 when inserted in Mr. Mowry's previously cold chamber, they will receive from that charcoal a heat—degree of heat—fully as great as is required by Mr. Whitney in the wording of his patent.

Q. 18. Then to return to the point of the examination as to the similarity of the processes. Mr. Whitney lowers his wheels into a chamber, you have said, previously heated to the temperature of the wheels when removed from the moulds, does he not?

A. He does.

Q. 19. In Mr. Whitney's process his chamber is a previously-heated chamber, is it not?

A. It is.

Q. 20. In Mr. Mowry's process his chamber is not a previously-heated chamber, is it?

A. I think it is a previously-heated chamber so far as the first wheel is concerned, and certainly so far as all the subsequent wheels are.

Q. 21. Mr. Mowry's furnace is not heated before any wheels are lowered in it, is it?

A. It is not.

Q. 22. Mr. Whitney's is, is it not?

A. It is.

Q. 23. In that, then, their two processes are different, are they not?

A. They are, but not essentially different.

Q. 24. Mr. Whitney's furnace or chamber is heated by fuel being placed outside, is it not?

(Question objected to for vagueness.)

A. It is not.

Q. 25. Does he place the fuel in the chamber to heat it in his process?

A. In heating large furnaces for large wheels the fires are
102 made directly within the cylinder or pit containing the wheels to be operated upon. Small wheels have also been treated in the same manner; but, for obvious economical purposes, he has several pits or chambers heated from one furnace, which furnace or fire is in direct communication with said pit, and to all intents and purposes is within the pit, and in no case have I ever heard of a fire having been made on

the outside of such a furnace, which of necessity would involve the heating of said furnace through the walls thereof.

Q. 26. The question that I desire you to answer is this: Whether the fire to heat the pit in which the wheels are placed is built in that pit, furnace, or chamber, or outside of it.

A. I think my former answer is directly in reply to this question. In large wheels, as practised now, the fire is made directly in the pit or chamber in which the wheels are placed.

Q. 27. Do the wheels then, when being placed in that chamber or pit, rest upon the fire or the fuel or upon the bottom of the pit?

A. They do not rest upon the fire, or rather, they do not rest upon the fuel, but are supported directly upon the bottom of the pit.

Q. 28. Whereabouts, then, is the fuel which is placed in the pit for the purpose of heating it?

A. Upon grate bars surrounding the central pier, upon which pier rest the wheels.

Q. 29. Are not those grate bars in fact outside of the pit or furnace in which the wheels are placed, and is it not so represented in the drawing to which you refer in your examination-in-chief?

A. They are not outside of the furnace or pit; they are directly within the pit, the heated gases or products of combustion passing directly from the fire or fuel to, among, and around the wheels placed within the pit precisely in the same manner as if the wheels had been laid directly into the fire. This drawing which has just been shown to me, and which I prepared, fully illustrates my meaning in the above answer.

(Drawing hereto annexed, marked Exhibit D.)

103 Q. 30. Is the process illustrated in this drawing the process which Mr. Whitney has always used in annealing his car wheels?

(Question objected to: First, as totally irrelevant; second, as totally incompetent—the witness having testified only to a general familiarity with Mr. Whitney's practice of annealing car wheels, and not being shown to have any knowledge of what Mr. Whitney has always used, and having already answered fully, so far as he knows, that Mr. Whitney uses the process illustrated by the drawing to the extent that he has stated.)

Q. 31. Question is amended by addition of the words, "so far as you know," and question repeated.

A. It is essentially the same.

Q. 32. What do you mean by essentially the same?

A. I mean by essentially the same, operating upon the same general theory. As, for instance, Mr. Whitney specifies in his patent that it is advisable to heat the pit or chamber to a certain degree of heat previous to the insertion of the red-hot wheels. He describes in his specification, as required by law, a certain means or device whereby this may be accomplished. I consider the location of the fire within the pit, or within any furnaces or chambers communicating directly with one or more pits, as essentially the same invention, being obvious mechanical equivalents for producing the same result, which result has been already expressed as the heating of said pit or furnace, or chamber.

Q. 33. In Mr. Whitney's process the wheels do not come in contact with the fuel, do they?

A. So far as I have seen the operation as conducted by Mr. Whitney,

or as described in his patent, and from his describing a mode of using hard or anthracite coal for the purpose of heating his furnaces or pits, he does not, nor would it be advisable for him to, let the wheels come in actual contact with the fuel.

104 Q. 34. In Mr. Mowry's process the wheels do come in contact with the fuel, do they not?

A. I believe they do come directly in contact with the fuel.

Q. 35. In this, then, the two processes are different, are they not?

A. I do not consider the contact of the wheel with the fuel, or non-contact of the same with the fuel, any essential difference in the theory of operation.

(Defendant's counsel objects to the answer as not being responsive to the question, not asking the witness for his opinion, or what he considers as to the theory of the two modes. Repeating his question, he insists upon a direct answer.

Complainant's counsel submits that the witness cannot be called upon to give an unqualified answer where he deems a qualification necessary to the correctness of it.)

A. They are different equivalent devices.

Q. 36. In the fact of the wheels in Mr. Whitney's process not coming at all in contact with the fuel, and in Mr. Mowry process that they do, in that part of the process then they differ, do they not?

A. I still cannot answer this question without a qualification, for this reason: The fuel used in both cases is first in a solid form; Mr. Whitney, from choice or convenience, describing the use of and using the hard or anthracite coal; Mr. Mowry describing and using, as I believe, soft, or charcoal. Mr. Whitney, as I have before said, does not place his wheels in contact with the solid part of the fuel; Mr. Mowry does place his wheels in contact with the solid part of the fuel used by him. The elevation of the temperature of the fuel used in either case results in the combination of the oxygen of the air with the carbon of the fuel used. Much of this fuel is volatilized, and still exists as a fuel, entering into combination with the oxygen to form carbonic acid, in direct contact in both cases with the wheels placed in the pit.

105 Q. 37. You have said that in Whitney's process the wheels do not come in contact with the hard fuel; that in Mowry's process they do. Is this a difference or not—yes or no?

A. This is a difference in the position of the two articles, namely, the fuel and the wheels.

Q. 38. In Whitney's process the hot wheels do not ignite the fuel that heats the pit or chamber, do they?

A. They do not.

Q. 39. In Mowry's process they do, do they not?

A. They do.

Q. 40. In this particular, then, the two processes differ, do they not?

A. Mr. Mowry and Mr. Whitney do kindle their fires differently.

Q. 41. In the particular, then, of igniting the fuels by the wheels, or the non-ignition of the fuel by the wheels, the two processes differ, do they not?

A. They do.

Q. 42. In Mr. Whitney's process the wheels are deposited in a chamber that has been "previously heated to a temperature as high as that of the wheels when taken from the moulds," are they not?

(Complainant's counsel objects to the question as a mere duplication of cross-question 14, which has already been answered by the witness.

Defendant's counsel replies that he failed to receive, in answer to

that question, any direct or specific answer, and now repeats it for the purpose of getting a direct answer to his question.)

A. It is so described in his specification, and to the best of my knowledge and belief, they are so treated.

106 Q. 43. There is no such description or direction in Mr. Mowry's specification, is there?

(Objected to, because the specification shows for itself.)

A. There is none.

Q. 44. In this, then, the processes described in the two patents are different, are they not?

A. The description of the two processes are different in this particular.

Q. 45. In Whitney's process, after the wheels are deposited in the furnace or chamber, the temperature of the furnace or chamber and its contents is raised to a point a little below that at which fusion takes place, is it not?

A. In Mr. Whitney's patent the words occur as quoted in the question; and in the process, as used by Mr. Whitney, to the best of my knowledge and belief, the temperature of the furnace or chamber is raised to a certain degree; but whether or not it be a few degrees below that heat at which fusion commences, I am not able to say.

Q. 46. Mr. Mowry's patent not containing any such description of his process in that particular, then, the two processes differ, do they not?

(Question objected to for a'biguity, and because Mr. Mowry's patent is not sued by this complainant, but Mr. Mowry's process, only one particular feature of which is the subject of his patent; and the question beginning with the patent and ending with the process, is calculated to mislead the witness, the two things being actually distinct. And further objected to as construing Mr. Mowry's patent.)

A. In Mr. Mowry's patent the words occur—"the charcoal becoming now ignited by the hot wheels, the cover of the pit is then laid on, and the damper opened so as to admit just sufficient air to effect the

107 combustion of the contained charcoal in the space of 72 hours, less or more, as may be found necessary for the annealing process." Mr. Mowry in his specification does not say exactly what amount of charcoal shall be placed in the furnace or pit to be consumed in the period of time named or indicated; but I believe that the process, as thus described, involves the necessity of a reheating of the wheels exactly as in Mr. Whitney's case, and that, although the precise words used by Mr. Whitney in his patent do not occur in Mr. Mowry's, yet still I conceive the processes as expressed to be the same.

Q. 47. Do you know whether in Mr. Mowry's process, the temperature of the furnace, after the wheels are placed therein, is actually raised to a point a little below fusion takes place, or not?

A. I do not know the exact temperature to which Mr. Mowry raises his wheels in this part of his process.

Q. 48. If the fact be that in Mr. Whitney's process, the temperature of his furnace is raised very nearly to that point at which fusion takes place, and the temperature of Mr. Mowry's furnace, after the wheels are placed therein, is not raised to nearly so great a degree, then in that particular the two processes differ, would they not?

A. If the fact be as stated, there would be a difference of degree, and not of essence or essential difference.

Q. 49. In Mr. Whitney's process all parts of each wheel are raised to the same temperature, and all parts, the thinnest and thickest parts of

each wheel, are allowed to cool and shrink simultaneously together, are they not?

A. They are.

Q. 50. If the fact be that in Mr. Mowry's process all parts of each wheel are not raised to the same temperature, the rims and the hubs at all times being a little cooler than the thinner parts of the wheel,
108 then in that particular the two processes would differ, would they not?

A. If the facts be as stated, the two processes would differ in degree and in result. Mr. Whitney's wheel being free from strains when cold, and Mr. Mowry's wheel containing strains produced by unequal contraction, as the result of slow cooling under varied degrees of temperature.

(Answer objected to by counsel for defence, as not being responsive to the question, and as volunteering testimony and statements as to the strains and contractions incident to the cooling by the two processes.)

Q. 51. My question is, if the fact be that in Mr. Mowry's process, all parts of the wheel are not raised to the same temperature, the rims and the hubs at all times being a little cooler than the thinner parts of the wheel, then in that particular the two processes differ, do they not?

(Complainant's counsel here enters an objection and protest against his client being put to the expense of a repetition of questions once answered by the witness, and explains to the witness that he is at liberty to give his reasons for his answer to any question based upon an hypothesis, so that the answer may show his understanding of the question; and that he is not obliged to answer such questions categorically, Yes, or No.

Defendant's counsel here objects, and enters his protest against complainant's counsel interfering in his legitimate and legal cross-examination of the witness, and protests against these frequent interruptions of his cross-examination, and these instructions and aids to the witness, and encouraging the witness in evading the questions and in giving long discursive answers, not at all responsive to the question, and in no way material to the subject of inquiry, and here insists upon a specific and direct answer to his question.)

A. If the facts be as stated, there is the difference in condition of the cooling wheels as specified.

109 Q. 52. If the fact is as stated, do the two processes differ, or do they not?

A. They differ in the manner I have already stated.

Q. 53. Will the witness now answer directly, whether they do differ, or do not, in that particular?

A. I have already said that they do differ in that particular, which is a condition of the cooling wheels.

Q. 54. In Mr. Whitney's process, after the wheels are placed in the furnace or chamber, and the temperature of the furnace or chamber raised to a point a little below that at which fusion takes place, all the avenues to the furnace or chamber are then closed, and the whole mass left to cool no faster than the heat it contains permeates through, and radiates from the exterior surface of the material of which it is composed, is it not?

A. This I understand to be part of Mr. Whitney's process.

Q. 55. After raising the furnace then, to its highest temperature, after depositing the wheels and closing the furnace, there is no control over the cooling, and no admission of air by valves or otherwise, is there?

A. There is no specific device in Mr. Whitney's process for admitting cold air to any particular part of the wheels in the pit, but there is for controlling the rapidity of the regular cooling.

Q. 56. Have you not just stated that in Mr. Whitney's process, after the deposit of the wheels, all the avenues to and from the interior of the furnace are closed?

A. They are closed in practice at one stage of the process.

Q. 57. What is that stage?

A. The stage of the process at which the avenues are closed, is when, in the judgment of the man in charge of the furnace, the wheels have been heated to a sufficient degree, and for a sufficient length of
110 time; then the dampers are closed, and if they be kept closed until the wheels are cold, the cooling operation will continue at a regular or uniform rate; but in my former answer, I meant that the dampers being devices under control of the workman, they could be used to regulate the rapidity of the cooling, which would nevertheless be uniform to a degree in all parts of the pit and its enclosed contents.

Q. 58. Are the dampers in Mr. Whitney's process used for the purpose of controlling the cooling of the wheels, and does Mr. Whitney's process contemplate the controlling that cooling by the admission of currents of air from the outside?

A. It does not contemplate the so controlling of the cooling process, and I do not know whether they use the dampers for such purpose.

Q. 59. Please state whether it is not the fact, that the only means of cooling contemplated or used in Mr. Whitney's process, so far as your knowledge extends, is by the radiation of the heat through the walls of the furnace, and that the heat that the wheels contain in Mr. Whitney's process, can only pass off through the medium of a confined atmosphere that intervenes between them and the walls of the furnace or chamber?

A. That is the process of cooling contemplated and practised.

Q. 60. Is that the mode of cooling contemplated and practised in Mr. Mowry's process?

A. It is not the only mode.

Q. 61. In that particular, then, the two processes of cooling differ, do they not?

A. They differ in that particular, by which I mean, the means of prolonging the cooling.

111 Without waiving the objections to the cross-examination taken by complainant's counsel, the witness is asked by him the following questions:

Q. 1. You have said that you are familiar with the general history of the art of annealing castings prior to the issuing of, or application for, the complainant's patent; do you know of any process of annealing, whether of castings of metal, or of other castings, in use, or described in any public work prior to the 2d day of August, 1847, which consisted of taking them from the moulds in which they were cast, before they had become so much cooled as to produce such inherent strain on any part as to impair its ultimate strength, and immediately after being thus taken from the mould, deposited in a previously-heated furnace or chamber, so constructed, of such material, and subject to such control that the temperature of all parts of the casting deposited therein might be raised to the same point, when they were allowed to cool so fast, and no faster than was necessary for every part of each casting to cool and shrink simultaneously together, and no one part before another.

(Objected to: first, as being leading in form; second, as going into the examination-in-chief upon a re-examination, and entering upon a

new field of inquiry as to which the defendant's counsel has no opportunity of cross-examination. Question waived.)

Q. 2. With what processes of annealing castings of metal prior to August, 1847, are you familiar, and how was such familiarity derived?

(Objected to as being new matter, and a subject that should have been inquired into, if at all, in the examination-in-chief.)

A. Previous to the time specified, processes for annealing castings of meial were confined to the covering or protecting of the cooling casting, by some non-conducting material, or, in some cases, piling fuel, generally charcoal, or some easily ignitible fuel, upon some par-
112 ticular part of the casting, which it was desirable to keep hot for a longer period of time than other portions of the same casting. Cold castings have been submitted to the action of fire, for the purpose of annealing, as the term annealing has been understood, within my recollection. My familiarity, to a degree, with annealing processes, began when I was a child, in watching the founding processes as conducted by my father and his successors in business, at the establishment of Coleman Sellers & Sons, Coleman Sellers being my father. That from the time of my familiarity with the business as there and then conducted, up to a period of about twenty years ago, I continued the notice of matters connected with the treatment of iron in its various branches; that, at the age of nineteen, I entered an establishment called the Globe Rolling Mills, at that time principally owned by Josiah Lawrence, in the city of Cincinnati. That, during my continuance in the employment of that concern, occupying a period of about three years, I had charge of the annealing processes as conducted in the manufacture of wire—that I had general charge of the mechanical construction of the machines and devices used in the establishment, such charge bringing me in general contact with the principal foundries and machine shops of the city of Cincinnati, and from my fondness for mechanic arts, inducing me to notice the condition of those arts as known or practiced at the time specified. After which, for a period of years, ending at about the time at which I entered into the service of Niles & Co., in the city of Cincinnati, being about fourteen years ago, I devoted my time exclusively to the study of mechanic arts, especially as related to the treatment of iron and other metals, conducted in the shops of Niles & Co., Miles Greenwood, and others in Cincinnati, and also in the Novelty Iron Works, in the city of New York.

(All the foregoing answer objected to by counsel for defence, as being properly testimony-in-chief.)

Q. 3. In your answer to cross-question 10, you state that your testimony upon the processes of the defendant and complainant, is based upon your reading and construction of the two patents. Do you mean that it was based upon them alone?

113 (Objected to as an illegitimate reëxamination of the witness, the answer of the witness to the interrogatory being direct and specific, and no explaination being necessary; the question can only have for its object the qualification and modification of the answer.)

A. I do not mean that it was based upon them alone; I am familiar with the manufacture of car wheels as conducted in the establishment of Mr. Whitney, and have read Mr. Knight's deposition in regard to the process as conducted by Mr. Mowry; also have had an explanation of Mr. Mowry's process, given to me by Mr. Corey, of the Niles Works, Cincinnati.

COLEMAN SELLERS.

JAMES DOUGHERTY, a witness produced on behalf of the complainant, being duly sworn, doth depose and say:

Q. 1. Please state your name, age, residence, and occupation.

A. My name is James Dougherty; my age is fifty and upwards; I reside in Philadelphia; I am now one of the firm of Bement & Dougherty; we are machinists and iron founders.

Q. 2. How long have you been engaged in the business of iron founding, and what is the extent of your familiarity with the various branches of that art?

A. I have been engaged in it since 1833; I believe I am familiar with all the branches of iron founding; I have been engaged continuously in the business since then.

Q. 3. Please state if you have any particular familiarity with the art of manufacturing cast-iron railroad car wheels, and during what period, and to what extent does your knowledge of such art apply? Answer fully.

(Objected to by counsel for def't.

A. I engaged in manufacturing car wheels in 1837, and am the inventor and one of the patentees of what was known as the double-plate car wheel, for which patent was taken in March, 1838. Previously
114 to inventing that wheel, when I first engaged in the manufacture of car wheels, my attention was called to the breaking of the wheels as then made with arms, and the hubs separated to allow their cooling in the process of casting without breaking. This breaking was through the tread of the wheel, between the spokes. To prevent that breaking, the wheel I invented was provided with two plates or discs, forming a continuous support between the tread and hub, and provision made to allow the contractions to take place without injury to the wheel. So far as I know, there had not been any successful casting of car wheels with plates or continuous support between the rim and the hub, previous to our invention—I mean previous to my invention heretofore spoken of. Attempts had been made, but had uniformly failed on account of the contractions incident to the chilling and cooling of the different parts of the wheel. The only wheels that had been successfully made, were what was known as the spoke and arm wheels, in which the hubs were separated to allow for the contractions in casting and cooling. I continued for some years in the manufacture of car wheels, and I believe I am familiar with the various kinds of wheels and processes.

(Answer objected to as entirely immaterial and irrelevant.)

Q. 4. To what difficulties was the uniform failure of the attempts which you have mentioned, attributable?

(Objected to.)

A. The difficulty arose from the contractions of the different parts of the wheel in the process of casting and cooling.

Q. 5. What was the effect of the contractions which produced this difficulty?

(Objected to as irrelevant.)

A. The effect of the contractions was to strain or break the wheels. The first contraction, due to the chilling of the wheel, cooled the periphery or tread more rapidly than the interior arms or other sup-
115 ports, and the following contractions of the interior parts caused strain or breaking, rendering it very difficult to cast the wheels so as to last any reasonable length of time. Very few, if any, were successfully made.

Q. 6. At the time of your invention and afterwards, was the manu-

facture of cast-iron car wheels a distinct branch of iron founding, or not?

A. As far as I know, it was not. Some parties were more largely engaged in the manufacture of that, than any other class of castings.

Q. 7. At the time inquired of, and afterwards, was the manufacture of cast-iron car wheels distinct from the manufacture of ordinary iron castings? and if you answer yea, state in what respect.

A. As a branch of casting it was distinct, the wheels requiring to be cast in chills to harden the peripheries, and requiring different iron from that used in ordinary casting, as all irons will not allow of the chilling or hardening.

Q. 8. Up to the year 1848, did this distinction continue, so that at that time, in speaking of cast-iron car wheels, any person familiar with that branch of the art of casting would have understood a cast-iron car wheel to mean a car wheel cast in a chill, as you have spoken of in your last answer?

(Objected to.)

A. The distinction did so continue; any one speaking of cast-iron car wheels understood them to be wheels cast in chills.

Q. 9. Up to the year 1848, how far had the difficulties which you have mentioned as occasioning the failure of prior attempts in this branch of manufacture been remedied or overcome, and by what means?

A. The difficulties had been to some extent, provided for and overcome by various forms given to the wheels, such as curving the
116 interior supporting structure, making the lines connecting the tread and hub of the wheel longer than straight lines. Very many forms were introduced and used by various wheel-makers, which more or less successfully overcame the difficulty.

Q. 10. Please state, if you know, of any means for overcoming these difficulties, more successful than variations in the forms of the wheel, up to 1848.

A. That was the only mode in which there was any success up to that time, so far as I know.

Q. 11. Do you know of any successful mode after that time? if yea, what was it? name the earliest, if there was more than one.

A. The mode discovered and used by Mr. Asa Whitney did overcome the difficulties of casting, and enabled founders to cast any form of wheel, when treated after being cast as provided in his mode.

Q. 12. Please look at the patent now shown you, granted to Asa Whitney, April 25th, 1848, and state if you have read and understand the process of manufacturing car wheels described in that patent.

A. I have read, and believe I understand the process and mode of treatment described in Mr. Whitney's patent.

Q. 13. What mode do you refer to, as discovered and used by Mr. Whitney in your last answer but one?

A. Taking the wheels, while yet hot, and before they had sufficiently cooled to be injured by the contractions straining the various parts, and placing them in a chamber heated so as to bring all parts of the wheels to a uniform temperature, prolonging the cooling, and maintaining the various parts at a uniform temperature until cooled below the point at which the contractions due to the inequalities of the parts and process of chilling would strain or injuriously affect them, thus
117 leaving the wheels free from any injurious effect arising from the contractions.

Q. 14. Please state if you find such a mode of treating cast-iron car wheels described in the said patent of Mr. Whitney.

A. I do find the mode of so treating them described in Mr. Whitney's patent.

Q. 15. Please state if said mode is so described in said patent in sufficiently clear and exact terms, to enable persons skilled in that branch of the art to which said mode pertains, to use and practise the same.

(Objected to.)

A. The specifications and illustrations of the patent are sufficient.

Q. 16. From your knowledge of the art of manufacturing cast-iron car wheels, at the date of said patent, what is your opinion as to the novelty, at that date, of Mr. Whitney's process, as described in his patent?

(Objected to as being totally irrelevant and incompetent. In this suit by Mr. Whitney vs. Mr. Mowry, for infringement of his rights under his patent, it is in no wise material to enter into an investigation to support the novelty of his invention, and could only become material when Mr. Whitney's patent should be attacked for want of novelty.)

A. I am satisfied that it was novel, and had not previously been used by iron founders.

Q. 17. What do you say as to its utility and value?

(Objected to, the utility and value of Mr. Whitney's invention not being in issue in this case.)

A. I consider it one of the most useful and valuable discoveries made in connection with car wheels.

118 Q. 18. What do you say, from your knowledge, as to its effect upon the progress of the art of manufacturing cast-iron railroad wheels?

(Objected to as totally immaterial, and irrelevant.)

A. The mode of treatment by Mr. Whitney enabled him, or others using such mode, to make the wheels more successfully; furnishing better and safer wheels than made by former modes.

Q. 19. Have you read, and do you understand the mode of annealing car wheels described in the patent granted to A. L. Mowry, May 7th, 1861, a copy of which is now shown you, and have you read a copy of the deposition of George H. Knight, taken in this case, and do you understand the mode of annealing car wheels described in said deposition as being used by defendant in this case?

A. I have read the copy of the patent of Mr. Mowry, and also the deposition of Mr. Knight, and I believe I understand the mode of treating car wheels as used by Mr. Mowry, as described in the letters-patent, and Mr. Knight's deposition.

Q. 20. State if the process practised by Mr. Mowry, as so described, embodies the process described in Mr. Whitney's patent.

A. I so understand Mr. Mowry's process; it provides for so treating the wheels after being cast, that they may be heated and cooled, so as to permit the different parts of each wheel to adjust themselves to each other.

Q. 21. Does he so treat the wheel by means substantially the same as described in Mr. Whitney's patent; if not, state any respects in which the two processes are substantially different.

A. As I understand the processes, the results of treatment by the processes of Mr. Whitney and Mr. Mowry, are the same. The exact modes of treatment differ somewhat; Mr. Whitney, placing the wheels

119 in a previously-heated chamber, and Mr. Mowry placing them in a chamber which becomes heated by fuel placed between the wheels, over and below them. There may be some other minor differences, in regulating and controlling the cooling.

Q. 22. Do I understand you to mean by your answer that these are substantial or essential differences?

(Objected to as a species of cross-examination of plaintiff's own witness, leading the witness to make qualifications of specific answers, which answers are of themselves complete and perfect.)

A. As I understand them, they are not; each process producing the same result, or substantially the same.

AUGUST 1ST, 1866.

Present, Messrs. Baldwin and Burnett.

Mr. Dougherty continued.

Cross-examination by Mr. Burnett:

Question 1. When did you first know, from your own experience, of car wheels being cast with chilled rims?

Answer. In 1837; I saw them cast as early as 1836, but in 1837 I cast them.

Q. 2. How early did you know of Mr. Whitney casting them with chilled rims, if at all?

A. In 1848. I was in Europe for over two years, and when I returned in 1848, I learned that Mr. Whitney was making car wheels. I can't remember being in Mr. Whitney's establishment before 1851, and actually seeing the wheels so cast. I had seen them on the road with Mr. Whitney's name on them, but I did not test the wheels to see that the rims were chilled.

Reëxamined by Mr. Baldwin:

Question 1. On your return from Europe, in 1848, under what circumstances did you learn of Mr. Whitney's process of treating car wheels?

120 (Objected to—calling for hearsay and incompetent testimony.)

Answer. I had friends in Columbia, Pennsylvania, who were engaged in manufacturing car wheels, where and with whom Mr. Whitney's process was frequently discussed in the winter of '48 and '49. We also had a lawsuit in Boston, in which the entire car-wheel matter was discussed in 1848 and 1849. The lawsuit was concerning my patent.

(The foregoing answer is objected to as based entirely on hearsay.)

JA'S DOUGHERTY.

ENOCH LEWIS, a witness produced on behalf of the complainant, being duly affirmed, doth depose and say:

Question 1. Please state your name, age, residence, and occupation?

Answer. Enoch Lewis; I am forty-four years old; I reside in Philadelphia; I am purchasing agent of the Pennsylvania Railroad.

Q. 2. Please state whether you have been connected with railroads for a number of years, and the character and extent of your familiarity with railways and their appendages. Answer fully.

A. I have been connected with the Pennsylvania Railroad since 1850, except for an interval of two years and a half, in the capacities of foreman of machine shop, division superintendent, and general superintendent, and since May 1st, 1866, have been purchasing agent for the Pennsylvania and Philadelphia and Erie Railroads, and am familiar with the equipment and working of railroads.

Q. 3. Please state the extent of your familiarity with the construction of machinery, and especially with the art of manufacturing railroad car wheels, as well prior to 1850, as since.

A. I learned the trade of a machinist with Eastwick & Harri-
121 son, of Philadelphia, and afterwards accompanied them, in 1844, to Russia, and was employed by them there in superintending a portion of their work of constructing the rolling-stock of the St. Petersburg and Moscow Railroad, in which a large number of cast-iron railroad wheels were made for that road. Since 1850 I have been familiar with the manufacture of wheels at the establishment of A. Whitney & Sons, in Philadelphia, and with their manufacture, to a small extent, in the foundry of the Pennsylvania Railroad Company, at Altoona, and with the use of cast-iron railroad wheels, in large quantities, on that road.

Q. 4. As a branch of the art of iron founding, is the manufacture of cast-iron railroad wheels distinct from that of ordinary castings; and if yea, in what respect?

A. It is a distinct branch of iron founding, inasmuch as the necessity of securing a good wearing surface for the wheel requires the employment of iron which possesses the necessary chilling properties, and the necessity of removing the strain produced by the casting of the wheel in chills, and consequent upon its form, require a peculiar process of cooling.

Q. 5. In speaking of cast-iron railroad car wheels, by what process of casting would persons skilled in that art understand such wheels to be made?

(Objected to as incompetent.)

A. They would understand them to be wheels cast in chills.

Q. 6. How long has this distinction between cast-iron railroad car wheels, and ordinary iron castings, and this application of the term in the art, been made and understood?

A. In this country, for more than 30 years, the term cast-iron car wheels has meant chilled wheels. It has been made a separate and distinct branch of the iron-founding business for eighteen to twenty years.

Q. 7. Prior to the year 1848 what difficulties existed in the art of manufacturing cast-iron car wheels?

122 A. The great difficulty in the manufacture of cast-iron car wheels prior to that date, arose from the unequal contraction of the parts in cooling, producing strains which rendered the wheels liable to fracture.

Q. 8. How far has this difficulty been overcome, if at all, and when first, and how?

A. I believe it has been entirely overcome by Mr. Whitney's process of prolonging the cooling of the wheels, which first came under my notice about the year 1851.

Q. 9. Please look at the patent granted to Asa Whitney, April 25, 1848, a copy of which is now shown you, and state if you have read and understand the contents thereof.

A. I have read it, and understand it.

Q. 10. How far does the mode of treating railroad cast-iron car wheels, described in said patent, agree with the mode practised by Mr. Whitney, and with which you have said you have been familiar?

A. It agrees with it fully.

Q. 11. Please look at the copy now shown you of the patent granted to A. L. Mowry, May 7, 1861, and state if you have read, and understand the mode of treating cast-iron wheels therein described?

A. I have read it, and believe I understand it.

Q. 12. Have you read the deposition of George H. Knight taken in this case, and a copy of which is now shown you, and do you understand the mode of treating cast-iron car wheels therein described by said Knight as being practised by the defendant, A. L. Mowry?

A. I have read it, and believe that I understand it.

Q. 13. How far do the modes of treatment of car wheels described in said Mowry's patent and in said Knight's deposition, as used by
123 said Mowry, agree with the mode of treating such wheels described in Mr. Whitney's patent, in principle and in mode of operation, and in effect produced?

A. I believe them to be substantially the same in principle, mode of operation, and effect produced.

Q. 14. What effect, if any, so far as you know, did Mr. Whitney's invention have upon the art of manufacturing cast-iron railroad wheels?

(Objected to as irrelevant.)

A. It enabled a better wheel to be produced at less cost than had been the case before the date of his invention.

Q. 15. Then what is your opinion as to the usefulness and value of that invention?

(Objected to as irrelevant.)

A. I consider the invention one of very great usefulness and value.

Cross-examined by Mr. Burnett:

Question 1. Has not the art of rendering iron castings more ductile and durable been long known and used by iron founders, and was it not so known and used long prior to Mr. Whitney's patent?

Answer. I believe that is so, though my knowledge in regard to it is only of a general character.

Q. 2. The principle, then, involved or embraced in Mr. Whitney's patent, of annealing castings by prolonging the time of cooling, permitting the thick and thinner parts to adjust themselves to each other during the process of cooling, was not new or original with him, was it?

(Question objected to.)

A. I cannot say that it was.

Q. 3. In your opinion was it, or was it not?

(Objected to on various grounds.)

A. I do not think it was.

124 Q. 4. Your having answered that the principle embraced in Mr. Whitney's patent, to wit: the annealing castings by prolonging the time of cooling, &c., was not new or original with him, the only thing then in your opinion that is new—embraced in that patent—is the mode by which that annealing or prolonging the time of cooling is done, is it not?

(Objected to because the witness has not answered with an "&c.," and the question is vague.)

A. I understand Mr. Whitney's claim to be for the mode in which he prolongs the time of cooling car wheels, as specified in his patent.

Q. 5. Then do I understand you as saying, that you do not think Mr. Whitney's claim embraces the principle of annealing cast-iron car wheels by prolongation of the time of cooling, but only the mode by which it is done—And second, that you think his process does not embody a new principle, but only a new mode of carrying that principle into effect.

A. I do not understand Mr. Whitney's claim to be for a mode of annealing iron castings, for the purpose of making them softer or more ductile, but to be for a plan of prolonging the cooling, so that all parts may cool together at the same temperature, and no strain be left upon the wheel. In answer to the second part of the question, it might be said that Mr. Whitney's plan was an application of a principle already known.

Q. 6. Then it is the mode only of the application of this principle, that you consider new in Mr. Whitney's process.

(Objected to.)

A. The mode of the application, and the application of it, to the purpose to which he applied it; I consider both novel.

Q. 7. I will ask you then, Mr. Lewis, if in Mr. Mowry's application of this principle, and his mode of applying it from the moment the wheels are taken from the moulds, it does not differ in every step of the process from that of Mr. Whitney's?

125 A. It does not seem to me that it does. The wheels are placed in a chamber, which, after the first wheel is lowered into it, for the rest of the wheels which are placed in it, is a previously-heated chamber; the temperature of the wheels is raised by the charcoal fire in it to an equal degree throughout the whole mass; it is closed, and they are allowed to cool gradually and simultaneously, by the escape of the heat through the surrounding brick work, substantially in the manner described by Mr. Whitney.

Q. 8. Supposing, Mr. Lewis, the fact to be, not as you have stated, but that Mr. Mowry's furnace is not closed, that the wheels are not allowed to cool gradually and simultaneously by the escape of the heat through the surrounding brick work, but that the whole process of cooling is, at all stages, regulated and controlled by the admission of currents of air through the furnace, would not the processes then, be essentially different?

(The witness enquires "What do you mean by through the furnace?")

A. So far as regulating the temperature by controlling the draft through the furnace, I understand Mr. Whitney's process to provide the means, and that the two processes in that respect are not essentially different.

Q. 9. Supposing that in Mr. Whitney's process, and in the description of the same in his patent, it is especially directed and provided that after the wheels are placed in the chamber, and the wheels raised to a certain temperature, that then all avenues to and from the furnace or chamber are to be closed, and the whole mass left to cool, solely by the radiation of heat through the walls of the chamber, and in Mr. Mowry's process no such thing is done, the wheels not raised to so great a degree of heat, the avenues to the furnace at no time closed, the cooling of the mass not occasioned by the radiation of heat through the walls of the chamber, but by the passage of currents of air through the mass,

126 then, if these be the facts, would not the two processes, after the wheels are lowered into the chamber, essentially differ?

A. In the case supposed by you, the processes would differ so far as the means by which the heat escapes, is concerned.

Q. 10. Do not the two processes essentially differ in the means by which the heat is applied to the wheels, after they are lowered into the chamber?

A. There is a difference in the fuel, and in the manner in which it is used, but the effect desired to be produced, and produced in both cases, seems to me to be substantially the same.

Q. 11. While the effect may be the same, are not the means used to produce that effect, essentially different?

A. The means used are different?

Q. 12. Does not Mr. Whitney commence lowering his wheels into a chamber or furnace, according to the process described in his patent, previously heated to a temperature as high as that of the wheels when taken from the moulds?

A. I understand that to be the case.

Q. 13. Does Mr. Mowry commence lowering his wheels by his process, into any such furnace or chamber?

A. I understand that the chamber is cold when the first wheel is lowered into it, but for all succeeding wheels, has become heated by the ignition of the charcoal with which the first wheel came in contact.

Q. 14. In this particular, then, that Whitney commences placing his wheels in a previously heated chamber, and Mowry in a cold chamber, the two processes essentially differ, do they not?

(Question objected to by complainant's counsel.)

A. They differ so far as I have stated in my last answer.

Q. 15. In your opinion, would Mr. Mowry's furnace or chamber,
127 at any time before the last wheel was placed in the same, or in fact until they had all been placed in the chamber, and the charcoal all ignited, and by a blast or current of air made to burn intensely, become heated to the degree designated in Mr. Whitney's process, to wit: as high a temperature as when the wheels were taken from the moulds?

A. I should think the chamber would require to be filled and closed before, in the case supposed, the temperature would be raised to the point designated.

Q. 16. Then up to that point of time, the two furnaces or chambers would differ as to the amount of heat they contained, and the processes differ in the amount of heat applied to the wheels in the furnaces?

A. There might be a difference.

Reëxamination:

Q. 1. In your cross-examination, you have been asked various questions as to certain differences in corresponding stages, between Mr. Whitney's process and that of Mr. Mowry. How far do such differences, in your opinion, constitute any substantial difference between the two processes, in mode of operation or in effect, as continuous processes or modes of treating cast-iron car wheels?

(Objected to: First. Because improper in form. Second. Seeking a repetition of testimony given in chief. Third. Leading the witness in a reëxamination, where no opportunity is left for cross-examination, to qualify, and as far as possible, nullify direct answers given to questions asked in legitimate cross-examination of matters called out in the examination-in chief.

Complainant's counsel replies that, on his examination-in-chief, the witness has been asked no questions now enquired about; and that he does not understand that according to the rules of evidence defendant's counsel is deprived of an opportunity for cross-examination upon his answer to this question, and if there be such want of opportunity,
128 unknown to him, he will offer the witness for recross-examination upon his reply when made.

The defendant's counsel rejoins that, in answer to the enquiry of complainant's counsel contained in the following words, "How far do the modes of treatment of car wheels, described in said Mowry's patent, and in said Knight's deposition, as used by said Mowry, agree with the mode of treating such wheels described in Mr. Whitney's patent, in principle and mode of operation, and in effect produced," the witness has answered, "I believe them to be substantially the same in principle, mode of operation, and effect produced." In the cross-examination of the witness, defendant's counsel took up the two processes described at their different progressive stages, and asked the witness whether at

these points the processes were different or not, confining himself strictly to a cross-examination of the witness' previous assertion that the mode of operation was substantially the same. The cross-examination having been so conducted, the complainant's counsel has no right, on a reëxamination, to reopen this subject and permit the witness to change, modify, or nullify previous answers; and defendant's counsel does not choose to avail himself of the proffered opportunity to further cross-examine this witness, the examination-in-chief and the cross-examination having been once properly and legally closed.)

A. I do not think the difference named constitute any substantial difference in the processes.

ENOCH LEWIS.

GEORGE WHITNEY, a witness produced on behalf of the complainant, being duly sworn, doth depose and say:

Q. 1. What is your name, age, residence, and occupation?

A. George Whitney; I am forty-six; I reside in Philadelphia; I am a car-wheel manufacturer; I belong to the firm of A. Whitney & Sons, and am a son of A. Whitney.

Q. 2. How long have you been engaged in the manufacture of car wheels, and to what extent?

129 A. Since 1847; and since then as one of the firm of A. Whitney & Son, and subsequently to the present time, of A. Whitney & Sons. Our business growing from a few hundred wheels, made the first year, to the present number of about fifty thousand per year.

Q. 3. What has been the process of manufacturing car wheels followed by you, or the firm with which you have been connected, during the period you have mentioned, and of what material have those wheels been made?

A. The process is, and always has been, that described in the patent granted to my father, Asa Whitney, April 25, 1848, for annealing and cooling cast-iron car wheels, and the material used has been pig-iron possessing chilling property.

Q. 4. Why have you used pig-iron possessing chilling property?

(Objected to as irrelevant.)

A. In order to produce the requisite chilled surface on the tread of the wheel to make it durable.

Q. 5. Please state the mode of casting such wheels, and the extent to which the chill goes?

(Objected to, there being no claim in Mr. Whitney's patent pertaining especially to chilled wheels, and the enquiry being generally irrelevant.)

A. The mould into which the melted metal is poured is composed of sand, excepting that portion which forms the tread and flange, which portion is made of iron; this iron portion of the mould giving to the melted metal what is called its chill; that is producing a white, hard portion of wheel, about ½ to ¾ of an inch in depth, all the other parts of the wheel being gray soft metal.

Q. 6. Prior to 1847, were you familiar with the manufacture of cast-iron railroad wheels as then conducted? and if you answer yea, please state the mode of such manufacture.

130 A. I was, though not as a manufacturer of wheels, but had a general knowledge of the different modes and patterns in use for making cast-iron car wheels. The most common way of making wheels was from a spoke pattern, having the hub divided to admit of the contraction caused by cooling. Various plate patterns were also in

use; the plates between the rim and hub being curved more or less, to provide for the contraction caused by cooling. After being cast, all these wheels, so far as my knowledge extends, were allowed to cool in the sand and chill in which they were cast.

Q. 7. Please state to what degree of success, the manufacture of cast-iron car wheels in 1847 had attained, compared with its subsequent progress, and state what difficulties remained in such manufacture at the time first mentioned.

A. Up to 1847, no cast-iron car wheels had been produced which satisfied the growing demands of the railroad service; all were more or less defective, inasmuch as when properly chilled, they were deficient in strength, and liable to break in service from the inherent strain left by the manner of their cooling.

Q. 8. What distinguishes the manufacture of cast-iron car wheels as a branch of the iron-founding art, from the manufacture of ordinary castings?

A. The necessity of producing a chilled surface on the tread to render the wheels durable, the use of iron possessing chilling properties which will give this chilled surface, and the necessity of providing for obviating the strain which is caused by this chilling of the tread during the cooling of the wheels.

Q. 9. How far back does this distinction between cast-iron car wheels and ordinary castings extend, as a part of the technology of iron founding?

A. As far back as in 1835, in my recollection.

Q. 10. To what extent, and with what advantages, were the difficulties and defects in the manufacture of cast-iron car wheels obviated or overcome by the process patented to the complainant?

131 A. They were entirely overcome, and enabled the manufacturer to make a wheel of any form of plate or spoke connecting the rim with the hub, which would give the greatest degree of strength with the least metal.

Q. 11. What was the effect of the complainant's improvement upon the safety of the wheels under high velocity, compared with wheels made prior to his invention?

A. There was a general confidence felt in regard to their strength as well as durability, which never had been the case regarding other wheels.

Q. 12. Have you read, and do you understand the mode of manufacturing car wheels described as being used by the defendant in the deposition of George H. Knight, a copy of which is now shown you, and the mode of such manufacture described in *he* patent of A. L. Mowry, dated May 7th, 1861, a copy of which is now shown you? and, if you answer yea, give your opinion as to whether such process of the defendant agrees with and embodies the process described and specified in the complainant's patent, and the grounds of that opinion.

A. I have read and do understand them, and think the process described and used by the defendant is identical in operation and results with that patented by the complainant; both taking red-hot wheels before they are injured by contraction in cooling; putting them in a furnace, chamber, or pit; then raising the temperature of the wheels to a uniform degree throughout, and then permitting them to cool so slowly that, when cold, no strain is left upon them by unequal shrinking.

Q. 13. What would be the effect upon the wheel of a process in which the temperature of different parts was raised unequally?

A. Strain would be produced upon the wheel by its cooling from said unequal degree of temperature in its several parts.

132 Q. 14. Do you know George H. Thacher, some time of Albany, New York; and, if yea, when and under what circumstances did you become acquainted with him?

A. I do know him, having become acquainted with him in 1855, I believe, at which time, or thereabouts, my father brought a suit against him for infringing the patent granted to him 25th of April, 1848.

Q. 15. What was done in said suit, so far as you know, and how did it terminate?

(Objected to; record being the proper evidence.)

A. Proceedings for an injunction were had, and I believe the injunction was granted, but Mr. Thacher could not be found for service of process. He was invisible, I believe, for some months. In the mean time he, as I am informed, sold out his foundry. A suit was then commenced against him for damages, and a large amount of testimony taken by him to endeavor to prove that my father was not the inventor of the process for which patent was granted to him April 25th, 1848. I know this as I accompanied the counsel of my father in taking the testimony. Mr. Thacher finally compromised the matter by paying to my father a sum a little exceeding the actual cost he had been subjected to, and agreed to desist from the further manufacture of wheels by the process claimed as an infringement, and, so far as I know, has desisted to this date.

Q. 16. Do you know from which of the parties to the said suit the compromise thereof originated?

A. So far as I have any knowledge, it originated with Mr. Thacher.

Q. 17. Have you any interest in this suit, or in the patent of the complainant under which it is brought?

A. I have none.

133 Cross-examined:

Q. 1. When and where did you first see a car-wheel cast with a chilled rim?

A. About 1835, according to my recollection. It was done in the city of Albany, and by Mr. Townsend, or at least that was the name of the proprietor of the foundry. It was about 1835.

GEORGE WHITNEY.

ASA WHITNEY, a witness produced on behalf of the complainant, being duly sworn, doth depose and say:

Q. 1. State your age, residence, and occupation.

A. I am in my seventy-fifth year; resident of Philadelphia; and I have called myself a machinist.

Q. 2. Are you the complainant in this case?

A. I am.

Q. 3. How long have you been engaged in the manufacture of railroad car wheels?

A. Since 1847; commencing in 1847.

Q. 4. State, as near as you can, how many wheels you have made since 1847, and to what extent you are now making such wheels.

A. I do not recollect the number exactly, but it is stated in this paper, marked Exhibit E, which is taken from the books of A. Whitney & Son, and of A. Whitney & Sons, and which I believe to be a true statement, up to the first of July, 1866.

134 EXHIBIT E.

Number of wheels made and annealed each year from commencement in 1847, *to July* 1*st*, 1866.

Year.	No. made.	Year.	No. made.	Year.	No. made.
1846		1854	17, 107	1862	42, 495
1847	480	1855	17, 142	1863	46, 301
1848	3, 033	1856	33, 562	1864	53, 526
1849	6, 852	1857	30, 903	1865	41, 371
				July 1,	
1850	10, 881	1858	14, 764	1866	25, 142
1851	12, 965	1859	24, 834		
1852	14, 463	1860	32, 934		208, 835
1853	15, 027	1861	20, 693	Recapitulation.	191, 939
					63, 701
	63, 701		191, 939	Total No	464, 475

It will be observed that the most considerable fluctuations from a tolerably uniform annual increase of the number of wheels made, commenced 1857, and again in 1861. These checks to a more uniform continued growth, are attributed mainly to the same causes as have affected similarly almost all other industrial branches of business, viz: The financial crisis commencing in 1857, and the rebellion in 1861. The first six months of this year we made 25,142, and we expect to make at about that rate during the residue of this year.

Q. 5. By what process, or mode of treatment have the wheels embraced in Exhibit E, been manufactured?

A. By the process described in my patent, dated April 25th, 1848.

135 Q. 6. When did you begin your experiments in the manufacture of car wheels, which experiments resulted in the invention patented to you as aforesaid?

(Objected to as immaterial and irrelevant.)

A. I commenced making some patterns in the latter part of 1846; but no wheels till 1847, and very few in that year; they were mostly experiments.

Q. 7. What did you deem to be your invention, and what did you intend to patent and understand to be patented to you as such?

(Objected to: first, as incompetent, being of no consequence what the complainant intended to patent or deemed to be his patent, if, in fact, his intentions were not carried into effect and no such patent obtained; and second, the letters-patent are the proper and only competent evidence of the complainant's invention and what he intended to patent.)

A. Annealing or prolongation of the cooling of car wheels, so as to prevent any inherent strain in the wheel when cool.

Q. 8. How did you do that?

A. By taking them from the mould in which they were cast as soon as they were cool enough to be removed without changing their figure. They were put into a pit or furnace that had been heated to nearly the temperature of the wheel. The wheels, as taken from the moulds, were put in these pits and piled one on top of another as soon as they were cast; an active fire was kept up until the pit or kiln was filled, and the temperature raised until the whole contents of the kiln was at the desired temperature; the furnace was then closed by putting on the top, and the atmosphere was not admitted to the fuel, and the flue to the chimney closed, so that there was no admission of atmosphere to the fuel or egress of heat from the furnace to the chimney. The wheels

remained in that condition until the heat had permeated through the structure in which they were enclosed, and the temperature was
136 so reduced that we could handle them, which was at about 212°. It required about three days. All of which is more particularly described in the schedule to the patent granted to me for that purpose. I do not remember exactly the wording of it; but these are the ideas.

Q. 9. What means did you provide for controlling, and to what extent could you regulate the quantity and intensity of the heat used in this process?

A. The fuel for raising the temperature was placed on a grate, as shown at the bottom of the annealing oven by a drawing appended to the patent; there was a door opening into an ash-pit under that grating, and a valve placed in the flue connecting the oven with the chimney, so that when the ash pit door was open and the valve in the flue open there would be an active combustion of the fuel. That was continued until we got the temperature desired; then the ash-pit door and damper were closed and luted up, and remained so until the temperature was reduced to about 212°, when the pits were opened and the wheels removed.

Q. 10. Have you at any time, and if yea, upon what occasion, prepared a statement respecting the progress of the art of manufacturing car wheels?

(Objected to as totally irrelevant.)

A. In my application for the extension of my patent I prepared such a statement, which was filed as a part of my application.

Q. 11. Please look at the certified copy from the Patent Office now shown you, and state if you have read such copy, and if the same is a copy of the statement referred to, to the best of your recollection, and if you answer yea, whether such statement is true in all its parts, to the best of your knowledge, information, and belief?

(Objected to: first, because such statement is in no way a record of such character as to be used in evidence in this case; second, the
137 statement is of no higher evidence than any oral statement made by the witness to any third party when not under oath, its being in writing in no way adding to its competency as an ex parte and a sworn statement; third, even if competent, as record evidence of the matters therein set forth, yet it is inadmissable, as containing matter wholly immaterial and irrelevant to the issue involved in this trial.)

A. I examined this copy and compared it with the original, and found it to be a true copy, and its contents are true, according to my information and belief.

(Complainant's counsel puts in evidence a certified copy of the statement referred to, and the same is marked by the commissioner, Exhibit F, and in reply to the objection of defendant's counsel, states that he substitutes the said copy in lieu of interrogatories touching the contents thereof, for the purpose of showing the state of the art, and for the further purpose of saving time and of relieving the complainant from the great fatigue of an unnecessarily protracted examination-in-chief.

Defendant's counsel objects to the introduction of this copy as evidence, and protests against the same being made part of complainant's deposition.)

Q. 12. Please state briefly the circumstances under which a compromise was effected by George H. Thacher of the suit brought by you against him, mentioned in your bill of complaint in this case.

A. I was passing through Albany, and remained there a day and met Mr. Thacher in the street, who had previously visited our place, and I became acquainted with him. He remarked that his friends and my

friends, which were about Albany, had said to him that he and I ought not to have a suit. I replied that I didn't want a suit, and didn't commence a suit for the purpose of making money out of it, but to stop him from making wheels and from invading my patent; that if he wanted to settle the suit I would be at the Delavan House all day, and by
138 his calling we would talk over the matter farther. He did call, and I stated to him that if he would stop making wheels, using my process, and pay me the expense that had been incurred in prosecuting the suit thus far, I would cancel the suit. He wanted to know what the expense was. I replied that I could not tell there, but would inform him as soon as I got home. I did very soon afterward inform him that I would limit the expenses to fifteen hundred dollars, which he subsequently assented to, gave me his note for that amount, which was paid at maturity.

(In the foregoing answer all statements of Mr. Whitney to Mr. Thacher, or the latter to Mr. Whitney, and all statements as to the contents of any written instruments, objected to as incompetent testimony.)

Cross-examination:

Q. 1. At the time you made your invention and applied for your patent you were aware, were you not, that difficulties had been met with by all operators in iron castings in obtaining sound and strong castings, by reason of the inequality in time of the cooling of the thin and the thick parts, and that different modes had been known and used to overcome this difficulty?

A. All persons familiar with iron foundry knew at that time that there was difficulty in getting strong castings from patterns of unequal thickness. I know of no mode of overcoming the difficulty at that time, except the common one resorted to of taking the sand from the thick part of the casting and exposing it to the atmosphere, the thin parts retaining the heat imparted to the sand about them, so that the cooling was so nearly equalized as to enable founders to make castings of considerable inequality in thickness.

Q. 2. You were aware then, were you not, at that time, that different means were known and used to anneal or prolong the time of cooling of castings or parts of castings, and by your invention you sought
139 to patent a new mode of using a well-known principle, did you not?

A. I knew of no other general means to equalize the cooling, other than that mentioned in my last answer. But in special cases, the form of the pattern might be such as to make it necessary to expend fuel on the casting after it was taken from the sand. This was done. This principle was well known, that is, that all metals are larger when hot than when cold, and when one part, by reason of its being thinner, loses its temperature sooner than the other, there will be inherent strain. The difficulty in making a car wheel was different from that of making a casting of thick and thin parts. In the car wheel the parts are very nearly equal in thickness, the metal forming the tread of the wheel comes in contact with the chill which forms that part of the mould, and is made of iron. All the other parts of the mould are made of sand. The iron being a good conductor, and the sand part of the mould a bad conductor of heat, that part of the metal coming in contact with the iron part of the mould, parts with his temperature very rapidly, and consequently its volume is diminished with its loss of temperature, the effect of which is to lessen the diameter of the wheel, and shove up the inner part of the wheel, which is in a semi-fluid state. When that inner

part loses its temperature, and comes down to the temperature of the chilled part, then commences the strain between the periphery and the inner parts of the wheel.

AUGUST 2, 1866.

Witness continued:

Q. 3. In your opinion, was there anything new in the taking of the wheels, or any casting, in a red-hot state from the moulds, and placing them in a furnace or chamber previously heated, or where heat was to be applied to them for the purpose of prolonging the time of cooling simply, of such wheel or casting?

140 A. So far as general castings are concerned other than wheels, I know of no mode of treatment except that described in my last answer. As to car wheels, I am not aware of any mode being adopted or practiced for prolonging the cooling by putting them into a furnace previously heated for that purpose.

Q. 4. Supposing your application or claim had been simply for the taking of the wheel in a red-hot state, and placing them in a furnace, chamber, or oven, and then applying heat to them for the purpose of annealing them, and had stopped there; in your opinion, would such claim have been patentable?

(Objected to, as matter of law, the witness not being a solicitor of patents, and not being shown to be familiar with the law applicable to patents for inventions.)

Q. 5. Question in its present form waived and amended by the substitution of the word novel instead of patentable.

(Question as amended objected to, because witness has stated that he knew of no such mode. The question is therefore merely repetition, after having been once fully answered.)

A. I suppose it would.

Q. 6. It is your opinion then, that up to 1848, in the casting of iron car wheels, it had not been known or practiced, that is to say, they had not been taken from the moulds, and placed in ovens, furnaces, or chambers, and there annealed by the application of heat.

(Question objected to, because the witness has stated that he has been engaged since 1847—commencing in 1847—(answer to question 3 direct,) in making wheels which were taken from the moulds and placed in ovens or chambers, and there annealed.)

A. I knew of no such matter being practiced prior to 1847, when I commenced to treat wheels in the way described in the patent granted me.

141 Q. 7. Up to the time of your application for your patent in 1847, had you any knowledge of car wheels being annealed, or the time of cooling prolonged, by any mode?

A. I had not.

Q. 8. Do you now know that different modes were used prior to that date?

A. I do not now know that any mode was used prior to that date. I have been told quite recently that wheels prior to that time were taken from the moulds, and covered up in dry sand to prolong the cooling. I I have heard of that only in one instance.

Q. 9. I ask you, Mr. Whitney, if after the wheels are taken from the moulds, and from the point where you commence to lower them into the chamber or furnace, your process and that of Mr. Mowry's does not differ at each step and stage of the process up to the time they are re-

moved from the chamber, pit, or furnace, taking Mr. Mowry's process to be such as described in his patent. In this question, I do not seek for your opinion, as to whether those differences are essential, or material, or not; but simply as to whether the several steps in the two processes are not, from the time indicated, in every particular different.

(The question objected to, as having the bottom knocked out of it by the qualification thereof, inasmuch as Mr. Whitney's patent is not for each stage of his process separately, and his claim against Mr. Mowry is not based upon any mere differences in such stages, independent of each other.

Defendant's counsel replies that he here earnestly protests against complainant's counsel, instead of making a direct, formal, or legal objection to defendant's question in the presence of the witness, and before the witness has answered a perfectly legitimate question on cross-examination, making a species of formal argument, that can have no other tendency or effectual result than that of instructing the witness in the form of answer to be given. Defendant's counsel insists this is unfair, and not the usual and legal mode of entering objection to questions.

142 Complainant's counsel, deferring to the reply, requests the examiner to amend his objection by inserting before the word "inasmuch and as irrelevant," and at the end of the objection, the further clause "And because the witness has not been interrogated in chief, and has not alluded either in his direct or cross examination to Mr. Mowry's process, and the question is not therefore in cross-examination." These amendments to the objection being made to explain the ground thereof, without any desire on the part of complainant's counsel to restrict the fair examination of this witness upon any matter involved in this controversy.)

A. The only difference, in my opinion, between my process and that of Mr. Mowry, is that incident to the different fuels employed by each. The effect is the same in both cases.

Q. 10. I do not inquire as to what the differences are incident to, but simply whether in fact, from the point of time indicated up to the time when the wheels are removed from the chamber, the two processes, step by step, are not entirely different?

A. I answer no.

Q. 11. Where do they agree, or are they similar?

A. In both processes, heat is communicated from the fuel employed to raise the temperature to the desired point, then combustion is arrested, and the contents of the chambers left to cool by the heats permeating through the structure, and radiating therefrom.

Q. 12. Supposing the fact to be (not as you have stated) that in both processes "heat is communicated from the fuel employed to raise the temperature to the desired point, then combustion is arrested, and the contents of the chambers left to cool by the heats permeating through the structure, and radiating therefrom," but that in Mr. Mowry process, the heat is not raised to so great a degree as that described in your patent; that at no time in Mr. Mowry's furnace is the combustion arrested by the closing of the avenues to and from the furnace, as in your

143 process, and the contents in Mr. Mowry's process do not cool by the heats permeating through the structure, and radiating therefrom, but are cooled by currents of air permitted to pass through the contents at the will of the operator. If these be the facts, then the processes are not similar, as stated by you, are they, and are they not entirely and essentially different?

A. It is not true, that supposition; but if true, there would be no essential difference in the effect produced by the two processes; supposing it to be true, it would be an imperfect attempt at accomplishing the end desired.

Q. 13. If my supposition be true, would the two processes then differ, or not? I do not inquire after the effect, or after the perfection or imperfection of the processes, but simply for a direct answer, whether, if in the case supposed, and the facts as stated in question twelve, the two processes would essentially differ?

A. They would only differ in one being more perfect than the other.

Q. 14. In your process you commence lowering your wheels into a previously-heated chamber; supposing that in Mr. Mowry's process he commences lowering into a chamber not previously heated, in this particular, then, the two processes would differ, would they not?

A. They would differ for an instant, in that particular.

Q. 15. In your process, the wheels do not come in contact with the fuel; supposing that in Mr. Mowry's process they do, and ignite the same, then, in that particular the two processes would differ, would they not?

A. They would differ for the instant of time required to ignite the charcoal which surrounds them.

Q. 16. Would they, or would they not, differ, in the fact that in one process the wheels come in contact with the fuel, and in the other they do not?

A. That does not make a difference in effect.

144 Q. 17. My question does not inquire after effect, but whether, the fact being that in one process the wheels come in contact with the fuel, and in the other they do not, in that particular the two processes would differ, or not?

A. That, of course, would be a difference, but it would make no difference in effect. The way we practice now, the fuel is forty feet from the wheels; that is, a part of it.

Q. 18. In your process, the temperature of the furnace or chamber is raised before the wheels are lowered into it, to the same degree as that of the wheels when taken from the moulds; supposing that in Mr. Mowry's process, the furnace or chamber is at no time raised to so great a temperature, then, in that particular, the two processes would differ, would they not?

A. They would differ in degree; one would be more economical and more perfect than the other.

Q. 19. In your process, after the wheels have all been lowered into the furnace or chamber, combustion is arrested, and all the avenues to and from the furnace or chamber closed; supposing that in Mr. Mowry's process that at no time is the combustion of the fuel arrested until it is burned out, and at no time the furnace closed, then in this particular the two processes would differ, would they not?

A. No, sir; in my process combustion is not arrested until the desired temperature is had on the contents of the oven; Mr. Mowry's process, the combustion continues till the desired temperature is had; it may burn up the fuel, or it may not. There is a difference, one being more perfect tha' the other.

Q. 20. In your process, after the wheels have been lowered into the furnace or chamber, and the desired temperature reached, combustion is arrested, and all avenues to the furnace are closed, the contents of the furnace are then no longer under the control of the operator, and

the mass cools only by the heat passing off through the walls of the furnace; is this not the case?

(Question objected to.)

145 A. That is the case, except that the contents are under the control of the operator, so far as would be necessary to apply more heat; but in practice, it is never found necessary, and is never done.

Q. 21. If, in Mr. Mowry's process, combustion is not arrested; that all avenues to the furnace are not closed; that the contents, for the purpose of cooling, are at all stages under the control of the operator; that the mass is not cooled by the radiation or permeation of the heat into and through the walls of the chamber, but is cooled by the passage of currents of air through the contents of the chamber, at the will of the operator, then, in these particulars, the two processes would differ, would they not?

A. They would differ as much as a possibility could differ from an impossibility; it would be impossible to prevent the heat from the contents of the furnace not to permeate through the structure, as described in his patent. It would be impossible to admit a free access of cold atmosphere into the contents of the furnace, and retain the temperature seventy-two hours, as described in his patent—be seventy-two hours in parting with the temperature.

Reëxamination:

Q. 1. In your answer respecting certain supposed differences between the two processes, you have said, two or three times, that one of said processes would be more perfect than the other; which of the two processes, in such cases, would be the most perfect?

A. In the supposed cases, the one represented as my process, I consider the most perfect.

Q. 2. Allow me to suppose one case; suppose you filled your pit with cold water, and placed your red-hot wheels directly from the mould in that pit, and suppose that Mr. Mowry laid upon the bottom of his pit a a bed of lumps of ice, placed his first red hot wheel upon that bed of ice, laid lumps of ice on top of that wheel, laid another wheel on

146 top of that, and so filled his pit with alternate layers of wheels and ice—under such circumstances how far would the two methods differ in their effect upon the wheel?

(Objected to, this course of examination being entirely improper and unauthorized upon a reëxamination of the witness.)

A. There would be no difference in effect, except in degree.

A. WHITNEY.

147 COMPLAINANT'S EXHIBIT C.

The U. States Patent Office to all persons to whom these presents shall come, greeting:

This is to certify that the annexed is a true copy from the file of this office, of the file wrapper and contents in re the letters-patent granted Asa Whitney, April 25th, 1848.

In testimony whereof I, T. C. Theaker, Commissioner of Patents, have caused the seal of the Patent Office to be hereunto affixed, this tenth day of May, in the year of our Lord one thousand eight hundred and sixty-six, and of the independence of the United States the ninetieth.

[L. S.] T. C. THEAKER.

To the Commissioner of Patents:

The petition of Asa Whitney, of the city of Philadelphia, and State of Pennsylvania, respectfully represents that your petitioner has invented a new and useful improvement in the process of manufacturing cast-iron railroad wheels, which he verily believes has not been known or used prior to the invention thereof by your petitioner. He therefore prays that letters-patent of the United States may be granted to him therefor, vesting in him and his legal representatives the exclusive right to the same upon the terms and conditions expressed in the act of Congress in that case made and provided, he having paid thirty dollars into the Treasury, and complied with other provisions of said act.

A. WHITNEY.

148 CITY AND COUNTY OF PHILADELPHIA:

State of Pennsylvania, ss:

On this thirty-first day of July, 1847, before the subscriber, an alderman in and for the city of Philadelphia, personally appeared the within-named Asa Whitney, and made solemn oath that he verily believes himself to be the original and first inventor of the process herein described of manufacturing cast-iron railroad wheels, and that he does not know or believe the same was ever before known or used; and that he is a citizen of the United States.

JOEL COOK, *Alderman.*

To all whom it may concern:

Be it known that I, Asa Whitney, of the city of Philadelphia, and State of Pennsylvania, have made a new and useful improvement in the process of manufacturing cast-iron railroad wheels, and I do hereby declare that the following is a full and exact description thereof.

My improvement consists in taking railroad wheels from the moulds in which they are ordinarily cast, as soon after being cast as they are sufficiently cool to be strong enough to move with safety, or before they have become so much cooled as to produce any considerable inherent strain between the thin and thick parts, and putting them in this state into a furnace or chamber, that has been previously heated to a temperature as high as that of the wheels when taken from the moulds. As soon as they are deposited in this furnace or chamber, the opening through which they have been passed is closed, and the temperature of the furnace or chamber, and its contents, gradually raised to a point a little below that at which fusion commences, when all the avenues to
149 and from the interior are closed, and the whole mass left to cool no faster than the heat it contains permeates through, and radiates from the exterior surface of the materials of which it is composed.

By this process, all parts of each wheel are raised to the same temperature, and the heat they contain can only pass off through the medium of the confined atmosphere that intervenes between them and the walls of the furnace or chamber; consequently the thinnest and thickest parts cool and shrink simultaneously together, which relieves them from all inherent strain whatever when cold.

The annexed drawings will show the form and size of the furnace or chamber which I have used to perform the process above described:

Fig. 1, represents a vertical cross-section of the furnace or chamber, and

Fig. 2, a horizontal cross-section of the same, on the line A. B.

In the former is shown a pile of wheels as they are placed to be annealed. The cover to the furnace, being movable, is raised when the

wheels are put in, and is then closed and covered with earth, to prevent the too rapid escape of the heat. The damper in the flue leading to the chimney is also closed, as shown in Fig. 2, after the wheels are put into the furnace, and the opening in the lower wall stopped by an iron plate banked with earth, which prevents the escape of the heat in that direction. The explanations on the drawings sufficiently describe the other parts of the furnace.

To heat this furnace, I have used anthracite coal, it requiring less than one-fourth of a ton to anneal two tons of wheels. The heat required to perform the process may, however, be obtained by the use of any other fuel that may be less expensive at the place where the process is to be performed, or the requisite heat may be taken in a suitable conduit from the furnace in which the metal is melted, from which the wheels are made, after it has performed that office, to the chamber in which the annealing process is to be performed. In either case, however, the
150 furnace or chamber must be made of such form, and have such appendages connected with it, as to enable the operator to control the quantity and intensity of the heat used, by admitting more or less of it into the chamber, and of excluding it entirely.

The advantages resulting from the process of prolonging the cooling and annealing, as above described, are, that the wheels may be made much stronger when made of the same weight, than they can be when cast and cooled in the ordinary manner; and railroad wheels having any form of spokes or discs connecting the rim and hub, if subjected to this process, will not require their hubs to be cast in sections, and the spaces between the sections subsequently filled with some suitable metal, and wrought bands put on to the hub. Wheels subjected to this process of cooling and annealing will be stronger, without bands on their hubs, than those of the same weight cast and cooled in the ordinary way, having the wrought-iron bands on. In this way the original cost is diminished, and the wheels rendered more durable than they would be when made in any of the ways heretofore employed.

I do not claim to be the inventor of annealing castings made of iron or other metal, when done in the ordinary way; nor do I claim to be the inventor of any particular form or kind of furnace in which to perform the process; but what I do claim as my invention, and desire to secure by letters-patent, is the process of prolonging the time of cooling, in connection with annealing railroad wheels, in the manner above described, that is to say—the taking them from the moulds in which they are cast before they have become so much cooled as to produce such inherent strain on any part as to impair its ultimate strength, and immediately after being thus taken from the moulds, depositing them in a previously-heated furnace or chamber, so constructed, of such materials, and subject to such control that the temperature of all parts of the wheels deposited therein may be raised to the same point, (say a little below that at which fusion commences,) when they are
151 allowed to cool so fast, and no faster, than is necessary for every part of each wheel to cool and shrink simultaneously together, and no one part before another.

A. WHITNEY.

Witnesses:
GEO. WHITNEY.
W. H. TALCOTT.

THO'S P. JONES, *Agent.*

No. 4351.] 7TH SEPT'R, 1847.

In conformity to an act of Congress, entitled "An act to promote

the progress of the useful arts," approved 4th of July, 1836, I have received of Asa Whitney, Philadelphia, Penn'a, thirty dollars, which sum has been placed to the credit of my account in the Treasury U. States, under date of 2d August, 1847, and for which I have signed a receipt. Patent cast-iron railroad wheels.

C. SELDEN,
Treasurer of the United States.

Registered.
S. S.

DANIEL GRAHAM,
Register of the Treasury.

PHILADELPHIA, *March 28th*, 1848.

Hon. EDMUND BURKE, *Com'r of Patents.*

SIR: On the 31st July last, I forwarded to the late Doct. Tho's P. Jones all the papers pertaining to an application for a patent for a process of annealing car wheels. Under date of Aug. 2, '47, the doct'r acknowledges the receipt of these papers by stating, "Your specification and drawings, with the office fee of $30, have been this morning received, and the application is now on file in the Patent Office."

Having been recently informed of the death of Doct'r Jones, and that he had referred his clients having applications for patents pend-
152 ing, to J. J. Greenough, esq., for any further attention that may be required in reference to them, I therefore have to request you to consider Mr. Greenough as my attorney and representative in procuring for me the patent referred to above, which I trust will now soon be issued.

I am, very respectfully, your ob't serv't

A. WHITNEY.

Asa Whitney,
1398. No. 5531.
Town of Philad.,
County of "
State of Penn'a,
Cooling and
Annealing
Cast-iron railroad wheels.

Received Aug. 2, 1847.
Petition, "
Affidavit, "
Specification, "
1 Drawing } process.
Model, }
Treasurer's certificate.
1 cash $30, Aug't 2, '47.
2-3 Examined Fitzgerald, April 10th, 1848.
Issue. H. H. Sylvester, 13.
Patented. April 25, 1848.
Recorded. Vol. 34, page 47.

J. J. Greenough.
T. P. Jones.

R

Improvement in annealing and cooling cast-iron car wheels.

153 EXHIBIT F.

The U. States Patent Office to all persons to whom these presents shall come, greeting:

This is to certify that the annexed is a true copy from the files of this office, of certain papers now on file in re the extension of the letters-patent granted Asa Whitney. Extended April 7th, 1862.

In testimony whereof I, T. C. Theaker, Commissioner of Patents, have caused the seal of the Patent Office to be hereunto affixed, this eighth day of January, in the year of our Lord one thousand eight hundred and sixty-six, and of the independence of the United States the ninetieth.

[L. S.] T. C. THEAKER.

PHILA., 10 *March*, 1862.

HON. COMMISSIONER OF PATENTS:

SIR: Railways and their appendages, so far as regards their application to general purposes of traffic, are contrivances so modern that it is not difficult to trace each step of improvement, from rude beginnings to more perfect adaptation of means to ends.

Railways and their appendages may be distinguished by attributing to the former the rails and substructures below them, and to the latter the "rolling stock," that is to say, the wheels and structures resting upon them, employed both as motors and vehicles in conducting
154 the traffic of the road. The rails and the wheels on which the matter is moved, must act reciprocally upon each other at the point of contact between wheel and rail, with this difference, however —in the aggregate each unit of the wheel's surface must come in contact with that of the rail as many times oftener as the length of the latter exceeds that of the circumference of the former, thus subjecting the wheel to a corresponding increased wear. The first wheels used on railways in England were at the mines, where both rails and wheels were made of wood. The change from wood to iron was simultaneous for both rails and wheels, and both were at first made of cast iron; these first cast-iron wheels were made in the usual way of casting iron, in sand moulds; they did but little service; the tread being no harder than any other part, a groove was soon worn into the same by the action of the rail upon it, so that besides being soon destroyed itself, the wheel thus defective, injured the rail by spalling off the edges. The next step of improvement in wheels was to make them of cast iron, having the surface of the tread hard, and all the other parts soft, so as to secure both strength and hardness, where each are respectively required. To accomplish this, that part of the mould in which the tread was formed was made of iron, and all the other parts of sand. Iron being a much better conductor of heat than sand, when the molten iron was poured into the mould, so much of it as came in contact with the iron part of the mould parted with its heat much more rapidly than that which came in contact with the sand part of the mould. This iron part of the mould is called the chill. In this way a rapid crystallization and change from the liquid to the solid state, was produced on the tread of the wheel; the surface of the tread thus formed being nearly or quite as hard as hardened steel. It was all that could have been desired, so far as mere hardness was concerned. But another difficulty presented itself, induced by this mode of hardening the tread—the wheels had no strength, would generally break from the inherent strain on them be-

fore they became cold, which inherent strain was produced as
155 follows: Iron in its molten state is about 1-96th larger than when cold; when this molten iron was poured into the mould, so much of it as came in contact with the chill, parted with its heat more rapidly than that in contact with the other parts of the mould, and it also diminished in volume more rapidly, as the loss of temperature and the decrease of volume must be simultaneous. This explains why wheels made as described above, were defective in point of strength. The tread or rim was connected with a solid hub or nave by arms or spokes, the molten iron was poured into the mould at the hub; thence it flowed out through the sand mould of the spokes to the tread, where it came in contact with the chill, and as soon as it touched the chill it was cooled, crystallized and reduced in volume almost instantly, while the metal immediately behind it, in contact with the sand, parted with its heat more slowly, and remained in a fluid or semi-fluid state much longer; the periphery of the tread cooling and shrinking first, reduced its diameter, while the hub and spokes remained in a fluid or soft state, presenting little or no resistence to the contraction of the tread or rim. But as these spokes and hub subsequently parted with their heat, and passed into the solid state, an inherent strain began to be exerted between the rim and hub, the spokes were too short, restoration of so much of their length as had been diminished by the prior cooling and shrinking of the rim was demanded, all parts of the wheel having passed into the solid state, and become comparatively unelastic, the spokes were severed by mere tensile strain before the temperature of the whole mass was reduced to that of the atmosphere. To remove this difficulty, the next step was to divide the hub into sections, instead of casting it solid; this relieved the spokes from the tensible strain they were subjected to when connected with the solid hub; the spokes connected with each of these sections were left comparatively free to contract in length, carrying the section of hub to which they were attached with them. To restore the requisite strength to the hub, the spaces between these sections were subsequently filled with some suita-
ble metal, and wrought-iron bands shrunk on to each end of the
156 hub, so as to hold firmly together all the sections, and the metal fillings between them. Cast-iron wheels of this description, with some slight modifications as to form and proportion, were generally adopted in England, and used until after the Liverpool and Manchester road was put in operation. At the high speed for railroad movement that was soon afterwards attained, wheels composed of a combination of cast and wrought iron, of various forms, were substituted for those made entirely of cast iron, as the latter were deemed unsafe at a velocity above 12 or 15 miles per hour. Railroad wheels made entirely of cast iron, substantially like those last above described, having their hubs divided into sections, were very generally adopted in the United States at the commencement of our railroad career; and wheels of that description continued to be almost the only kind used up to as late as 1840. At about that date our roads began to be made more substantial and unyielding, and higher velocities of movement upon them began to be demanded. Under these circumstances the cast spoke wheel began to show its defects more prominently than before. Among the objections to them were the expense of filling the spaces between the sections, and putting the wrought-iron bands on the ends of the hub, and the difficulty of boring out the divided hub so as to make as good a fit on the axle as was necessary to secure it from becoming loose. If these things were not effectually done, the wheel was likely to break or

change its position on the axle, so as to throw the cars from the track. To avoid these difficulties, other means were employed to compensate for the unequal cooling and shrinking of the parts, than that of dividing the hub into sections and otherwise to make the cast-wheel more secure against breaking. These efforts began to be made early in our railroad history; they were all, or nearly all, confined to the idea of making the hub solid, and connecting the hub and rim by a disc or plate, which were generally made double. two plates extending from hub to rim, in form concave or convex, so as to be susceptible, as was supposed, of contracting or expanding in diameter as much as
157 would be required by the unequal cooling and contraction before noticed. These wheels, when skil'fully made, were an improvement on the spoke wheel, with the hub divided into sections, so far as safety was concerned, but they were still faulty as to cost and durability.

In order to counteract the inherent strain incident to the unequal cooling and contraction, it was necessary to make the plates composing the disc much heavier than the spokes had been for which they were a substitute. If the disc were made as light, and of as hard or high-tempered metal as the spoke wheel had been, they would break. It will readily be seen that there was no principle in the mere form of convex or concave plates that could be made available to compensate for the unequal contraction that must be encountered in making iron castings of any form, in moulds composed of unequal powers of conducting heat. If we undertake to increase the diameter of a convex circular plate, the circumference must be enlarged, which subjects the material of which it is composed to a direct tensile strain sufficient to elongate or sever it, and the reverse of this must occur if the diameter is to be diminished. These convex and concave plates could not therefore have had much if any more capacity of contraction or expansion than plain plates, and so it proved; for they did not answer the purpose expected until their thickness was increased so as to make the wheel of which they formed a part 10 to 12 pounds heavier than the spoke wheel with its hub divided into sections.

As soon as these disc wheels were properly proportioned and skilfully made, they were very generally adopted, but they were more expensive because heavier than they would have been had there been no more metal in them than was usefully employed; or in other words, if there had been no inherent strain, so as to produce a contest between the centre and periphery of the wheel.

The next effort was to prevent this inherent strain, not by the form of pattern from which the wheels cast, but by subjecting them to a process after being cast, with a view of controlling their loss of
158 heat, so that all parts of the wheel should cool and shrink simultaneously.

This process consists in taking the wheel from the mould in which it has been cast, as soon as it has become sufficiently cool to be strong enough to bear moving without changing its figure, and before it has become so much cooled as to produce any considerable inherent strain between its parts, and in this state putting it into a furnace or chamber that has been previously heated to a temperature as high, or nearly as high, as that of the wheel when taken from the mould. In this way, each successive wheel in the order in which it has been cast, is passed into a furnace or chamber of this kind, the opening through which they are passed being closed during the interval between their being thus placed, and as soon as the whole number designed to be deposited in one of those chambers has been put in, the opening is more permanently

and perfectly closed, so as to prevent the escape of heat through that aperture. The temperature of this furnace or chamber, and its contents is then gradually raised to a point sufficiently below that at which fusion begins, to avoid disturbing the previous crystallization of the wheel; all the avenues to and from the interior of this furnace are then closed, combustion ceases, and the whole mass is left to cool no faster than the heat it contains permeates through, and radiates from the exterior surface of the furnace. The wheels subjected to this process, remain in these heated chambers three or four days after they are cast, and when taken out their temperature is somewhat above 212° Fahrenheit. By this process all parts of each wheel are raised to the same temperature, and that so high as to render the metal sufficiently soft to yield readily to the relief of any inherent strain that might have begun to exist from previous unequal cooling, and the temperature thus attained can only be reduced by passing off through the medium of the confined atmosphere that intervenes between the pile of wheels and the brick walls of the furnace or chamber; consequently all parts of each wheel must cool and shrink together in the same time, which relieves them from all strain whatever, when cold.

159 I claim to be the inventor of this process, for which letters-patent were granted to me for the United States, April 25, 1848.

It was predicted at the outset, that to subject wheels to this process would deprive them of that peculiar hardness imparted to them through the agency of the chill, but that prediction has been proved incorrect by experience in use of the wheels thus made.

Although no theory yet developed, I believe, explains satisfactorily why the crystal of each crystalline substance differs in its geometrical form from that of any other substance, while there is a uniformity of shape in the individual crystals of each of those substances, yet we know that all crystallized matter must have existed in a liquid or æriform state, and that whatever may be the case as regards other substances, in iron the change from the liquid to the crystalline state may be more or less rapid, that the change is always attended with loss of heat, and that the size and particular mechanical arrangement of the crystals depend very much upon the rapidity with which this metal parts with its heat in undergoing this change. In making these chilled wheels, as before stated, the molten iron is poured into the mould at the hub, thence it flows outward until it comes in contact with the chill: that being a good conductor of heat, carries it off very rapidly from the liquid metal, thus crystallization commences at the surface of the tread laying against the chill; its superior conducting power extending inwardly, influences the form and arrangement of crystals, until arrested by the metal immediately behind it ceasing to be fluid. All irons are not affected in the same way, or to the same extent by this hurried cooling, those that part with their heat most reluctantly being affected most by the chill. It is this kind only that is suitable for wheels, and when worked at the proper temper, the wheels made therefrom, broken across the tread, show a white hue, immovable, next the chill, about half an inch in depth; inside of this a lively grey color, the white and grey not being separated by a definite line, but the two colors

160 merging into each other, and white and grey mottled intervening, penetrated by fine sharp white lines extending into the grey, resembling in figure the lines of frost in the snow-flake. The cleavage is at right angles to the surface of the chill, and the whole configuration of form and mechanical arrangement of crystals in the white and hard part of the wheel, shows clearly that that particular form of crystalliza-

tion commenced at the surface in contact with the chill, and penetrated inwardly. This peculiar form and character of crystallization having been produced while the iron was in a fluid and semi-fluid state, and the mechanical arrangement of crystals having then become fixed and immovable, they cannot be relatively altered in form or character until the iron is reduced to approximately the same state of fluidity it was in when this crystallization was formed.

The furnaces used in performing this process of cooling described above are so constructed that the combustion of fuel used for heating them may be rendered more or less active at pleasure, and with little experience the attendant has no difficulty in raising the temperature high enough to accomplish the object effectually. The heat required is far enough below that at which fusion commences to leave a sufficient margin between them, so that there is no difficulty in obtaining uniform and satisfactory results. Cast-iron chilled railroad wheels treated in this way, are made with solid hubs, and of any form of spoke or disc, freed from all inherent strain without the chill being injuriously affected, and of considerably less weight for the same strength, than those made in any other way. In a word, this process of prolonged cooling annihilates all the difficulties that had been encountered in making chilled wheels, and that without being the cause of any new difficulty.

I am, respectfully, yours, &c.,

A. WHITNEY.

161 UNITED STATES OF AMERICA,
Eastern District of Pennsylvania, ss:

Be it remembered that, on this seventeenth day of September, 1866, I, Charles Sergeant, United States commissoner in and for said district, duly appointed and commissioned by the circuit court of the United States, third circuit; also duly appointed special examiner in the cause hereinafter named, did call and cause to be, and personally appear before me in the city of Philadelphia, in the State of Pennsylvania, district aforesaid, Thomas W. Mason, John H. Redfield, and Henry Snyder, to testify and the truth to say on the part and behalf of the complainant, in a certain cause now depending, and undetermined in the circuit court of the United States for the southern district of Ohio, wherein Asa Whitney is complainant, and A. L. Mowry is defendant. And it being stated to me by Henry Baldwin, jr., counsel for complainant, that in his opinion the testimony of said witnesses is material and necessary for the complainant in the prosecution of said cause, and that the testimony in said cause, by a decree of said court, is to be closed by the third Monday of September, 1866, to wit, this 17th day of September, 1866; said counsel therefore requests the commissioner to examine said witnesses, and to file and transmit the documentary and other evidence hereinafter mentioned and marked as exhibits, and also the models hereinafter offered with the depositions of said witnesses, to be used on behalf of said complainant on the hearing of said cause, in pursuance of act of Congress in such case made and provided.

And thereupon complainant's counsel offers, and puts in evidence, a certified copy of the declaration, plea, and stipulation, in a suit wherein Asa Whitney was complainant, and George H. Thacher was defendant, sometime pending in the United States circuit court for the northern district of New York, which copy is accordingly marked Exhibit "G."

Certified copies from the Patent Office, of letters-patent of the United States, for improvements in railroad car wheels, numbered and
162 dated respectively as follows: No. 2212, granted to John Elgar,

November 19th, 1833, marked Exhibit "H;" No. 611, granted to H. R. Dunham, February 15th, 1838, marked Exhibit "I;" No. 637, granted to Bonney, Bush & Lobdell, dated March 17th, 1838, marked Exhibit "J;" No. 640, granted to Truscott, Wolf & Dougherty, dated March 17th, 1838, marked Exhibit "K;" No. 4330, granted to G. W. Eddy, December 26th, 1845, marked Exhibit "L;" No. 5076, granted to G. W. & H. Sizer, dated April 17th, 1847, marked Exhibit "M;" No. 32252, granted to A. L. Mowry, May 7th, 1861, and marked Exhibit "N."

And THOMAS W. MASON, a witness produced by and on the part of the complainant, and being duly sworn, in answer to interrogatories propounded to him, did depose and say:

Question 1. What is your name, age, residence, and occupation?

Answer. Thomas W. Mason; I am forty-two years old; I reside in Spring Garden street, Philadelphia; I am a model maker.

Q. 2. Look at the models now shown you and marked respectively Ex. O and Ex. O', and state if you have seen them before, and if you know what they represent.

A. They are models that I made for Mr. Asa Whitney. Exhibit O represents an annealing furnace for annealing car wheels, patented by A. L. Mowry, May 7th, 1861. Exhibit O' represents the flanged tube or pipe marked Exhibit "C," in the deposition of George H. Knight, of the 9th of April, 1866, and described by him, and represented as being used in the place of the pipe marked *d* in Mr. Mowry's patent.

Q. 3. What was your guide in making Exhibit O and Exhibit O'?

A. A certified copy of Mr. Mowry's patent for Exhibit O. Exhibit O' was copied from drawing Exhibit "C" in Knight's deposition.

Q. 4. Look at model marked Exhibit "P," and state, if you know, what that represents.

163 A. That is a model for an annealing furnace for the same purpose as the other, which I also made for Mr. Whitney.

Q. 5. What was your guide in making Exhibit "P?"

A. I made it from a drawing furnished me with a printed copy of the patent granted to Mr. Whitney, April 25th, 1848.

Q. 6. Look at the drawing now shown you, annexed to a certified copy of said patent, and state how far that agrees with the drawing you had before you in making Exhibit "P."

A. They are precisely the same.

Q. 7. Look at Exhibit "P'," and state, if you know, what that is.

A. That is intended for the stack, such as would be used with Exhibit "P."

Q. 8. In making said Exhibits, Ex. O, and Ex. O', and Ex. P, had you any other guide than the specifications, drawings, and Exhibit "C," which you have mentioned?

A. I had no other. I followed them strictly so far as the materials of which the models are made may stand for the material as represented in the drawings.

THOMAS W. MASON.

JOHN H. REDFIELD, a witness produced by and on the part of the complainant, and having been duly sworn, in answer to interrogatories propounded to him, did depose and say:

Q. 1. What is your name, age, residence, and occupation?

A. John H. Redfield; I am fifty-one years old; I reside 216 West Logan square, Philadelphia; I am cashier and inspector of car wheels in the works of A. Whitney & Sons, of this city.

Q. 2. What constitutes the inspection of the car wheels at those works?

A. We test the tread of the wheel for the hardness and perfection of chill by a cold chisel, and the plate for toughness and freedom from all strain or tendency to crack by blows on the plate and tread with the sledge hammer.

164 Q. 3. About how many car wheels have you thus inspected at the works of A. Whitney & Sons?

A. About eighty thousand.

Q. 4. What was the result of that inspection in detecting imperfections by reason of the chill of the tread being drawn or destroyed?

A. It is very uncommon to find such an effect; not two in a thousand.

Q. 5. What is shown by that inspection as the result of the process upon the plates of the wheels or unchilled parts?

A. It is still more rare to find any wheel the plates of which are wanting in strength and toughness. The process relieves them of such strain.

Q. 6. To what do you attribute such defects as you have found in destroyed chills or strained plates?

A. I attribute it entirely to want of proper management or carelessness of the workmen in charge of the fires.

Q. 7. By what process have the wheels you have inspected been made?

A. Under Asa Whitney's patented process of April 25, 1848.

JOHN H. REDFIELD.

HENRY SNYDER, a witness produced by and on the part of the complainant, and having been duly sworn, in answer to interrogatories propounded to him, did depose and say:

Q. 1. What is your name, age, residence, and occupation?

A. Henry Snyder; I am fifty-one years old; I reside in the city of Philadelphia; I am an iron moulder, and foreman of the foundry, and have charge of the yard at the car wheel works of A. Whitney & Sons, of this city.

Q. 2. How long have you been engaged in iron founding; how long have you been familiar with the manufacture of car wheels; and how long have you been a foreman with A. Whitney & Sons?

165 A. I have been engaged in iron founding since I was fourteen years; I have been among car wheels these last thirty years; I commenced with Mr. Whitney when he first started, early in May, 1847, and have been with him ever since.

Q. 3. State, if you know, what is the effect of Mr. Whitney's process of manufacturing car wheels upon the chill of the wheel or the chilled part of the wheel.

A. It does not affect the chill at all.

Q. 4. What is the effect of his process upon the unchilled parts of the wheel?

A. The effect is to take the strain off.

Q. 5. How many wheels, on an average, of those manufactured by Whitney & Sons have the chill drawn or destroyed in the course of his process?

A. Sometimes we run a month, and do not disturb a chill. Then, again, if we happen to fire up a little too strong, we may burn a wheel or two. When this happens, it is an accident, and it is attributable to the fireman not paying attention.

166 Q. 6. Look at the model now shown you, marked Ex. "Q," and state, if you know, what it represents.

A. That is the model of a cut-hub car wheel.

Q. 7. Where did you ever know such wheels to be made?

A. I have made them in Baltimore, for a man by the name of Robinson, about thirty years ago—about the time I was free.

Q. 8. Do you know of any split-hub wheels being made now-a-days?

A. No, sir; nobody at all.

Q. 9. Look at the model now shown you, marked Ex. R., and state, if you know, what it represents.

A. That represents a double-plate wheel, called the Bush and Lobdell wheel, with the divided hub.

Q. 10. Look at the engraving now shown you, marked Ex. S., and state what that represents.

A. That represents A. Whitney & Sons' car-wheel works.

HENRY SNYDER.

167 UNITED STATES OF AMERICA,
Eastern District of Pennsylvania:

U. S. circuit court, southern district of Ohio. In equity.

ASA WHITNEY
vs.
A. L. MOWRY. } No. 534.

Be it remembered that, on this first day of October, 1866, before me, Charles Sergeant, United States commissioner and special examiner in the above-entitled cause, at the office of A. Whitney and Sons, in the city of Philadelphia, personally appeared the above-named complainant, by his counsel, Henry Baldwin, jr., and the said defendant, by his counsel, Charles B. Collier, esq.; whereupon it is agreed by the defendant, that the testimony, exhibits, and models taken and put in evidence on the 17th day of September, 1866, and heretofore transmitted by me, the said examiner, to said court, may be used at the hearing of this cause, the same and with the same effect as if regularly taken and proven herein with notice, and the complainant offering to produce for cross-examination the witnesses, Thomas W. Mason, John H. Redfield, and Henry Snyder, defendant's counsel waives the cross-examination of the first two named witnesses, and propounds to the said Henry Snyder the following cross-interrogatories:

Question 1. What was the form of the wheel manufactured by Mr. Whitney, in May, A. D. 1847, and wherein did it differ, if at all, from the wheels now manufactured by him?

Answer. The first shape of the wheel was a bugle wheel, or a corrugated plate wheel, the corrugation being bugle shaped. The wheels now have a straight plate, with brackets on the back.

168 Q. 2. State whether the process of Mr. Whitney, referred to by you in answer to question three, is the process now practised by Mr. Whitney, at his establishment?

A. Yes, sir; it is.

Q. 3. You will now please describe, particularly, that process.

A. The wheel is moulded in sand, except the tread, which is moulded in a chill, the chill forming the tread of the wheel. After the wheel is cast, we take it out of the chill while it is red, and put it into the furnaces that are heated up; we fill the furnaces full of wheels and then shut them up; then we let the fire operate in those furnaces to equalize the heat of the wheels; then we shut the draft off. We leave them in until the fourth day, and that completes the process.

Q. 4. State whether these wheels in the annealing pit or furnace are heated to a point say a little below that at which fusion commences.

A. I don't think we heat them up as high as that; we only keep them at a red heat.

Q. 5. What is the result of your observation as to the effect upon the chill where they are heated to a point at all approaching or anywhere near that at which fusion commences?

A. If that question is as to the effect, if you heat them up to a soft state, you draw the chill out; if you heat a wheel to near fusion you draw the chill out. We don't want to heat them any hotter than a cherry red.

Q. 6. State how much hotter, if any, they are made than when taken from the moulds.

A. We let the heat operate in there to equalize the heat of the wheel to take the strain off. We make them hotter; that is, the rim and plate, but I cannot say how much; I mean I can't tell in degrees. We have to determine this by practice.

Q. 7. Do you reheat them now, more or less than you did when you first commenced to use Mr. Whitney's process?

169 A. We don't heat them any more; we only heat them enough to take the strain off; about the same as we did at first—no more and no less.

Q. 8. Suppose you take your wheels from the moulds at a red heat, and put them in that state into your annealing pits, the latter not having been previously heated, and at the instant of placing the first hot wheel in the cold pit you introduce the heat from the furnace into the annealing pit, and then deposit the other wheels successively in the pit, would the effect upon the wheels thus annealed (the subsequent stages of the process being the same as that now practised by you) be the same as the effect produced by the process you have described?

(Objected to as not cross-examination.)

A. I have never had any experience of that kind at all; we have never tried it.

Q. 9. How long is the heat introduced into your annealing pit before the wheels are placed into it?

A. That depends on circumstances; if the fire is strong, we can put the wheels in in two hours after first lighting up the fire in the furnace.

Q. 10. What changes, if any, have been made in the annealing process used at Mr. Whitney's establishment, since 1847?

A. In 1847 we had the fire right in the annealing oven where the wheels were set; now the fire is outside the annealing oven altogether; now the fire is made in the furnace outside, and the flame is worked into the annealing oven through the flue. There have been no other changes as regards annealing them.

HENRY SNYDER.

170 UNITED STATES OF AMERICA,
Eastern District of Pennsylvania:

I, Charles Sergeant, United States commissioner, in and for said district, and duly appointed special examiner in this cause, hereby certify that, on this seventeenth day of September, 1866, personally appeared before me, in the said city of Philadelphia, by his counsel, Henry Baldwin, jr., Asa Whitney, the complainant, in a cause now depending and undetermined in the circuit court of the United States for the southern district of Ohio, wherein A. L. Mowry is defendant. That, at the request of said complainant, I did call and cause to appear before

me, Thomas W. Mason, John H. Redfield, and Henry Snyder, whose depositions were then and there taken before me, and by me reduced to writing, and subscribed by said witnesses respectively in my presence, the said witnesses and each of them having first been duly and carefully examined, cautioned, and sworn to testify the truth, the whole truth, and nothing but the truth. I have detained the said depositions in my possession for the purpose of properly certifying the same, and depositing them in the post office with my own hand, directed to the court for which the same were taken.

And I do further certify, that the said witnesses are all of sound mind and lawful age, and do all reside in the said city of Philadelphia, a greater distance than one hundred miles from the southern district of Ohio, the place of trial of the said cause, and that I caused no notification to be made out and served on the defendant of the time and place of taking said depositions, because his place of residence was unknown to complainant and his counsel and to me, nor upon the counsel of defendant, because they reside more than one hundred miles from the city of Philadelphia, the place of taking the said testimony.

And I do further certify, that I am not of counsel or attorney to either of the parties in said cause, nor in any way interested in
171 the event of said cause. Certain of said exhibits being models, and not capable of being transmitted by mail, have been forwarded by me, carefully directed, by express.

In witness whereof I have hereunto set my hand and official seal, at Philadelphia, this 17th day of September, A. D. 1866.

CHARLES SERGEANT,
United States Commissioner.

EXHIBIT H.—*Elgar's patent, Nov.* 19, 1833.

The schedule referred to in these letters-patent, and making part of the same, containing a description in the words of the said John Elgar himself, of his improvement in the wheels of railroad carriages.

To all whom it may concern:

Be it known that I, John Elgar, civil engineer, of the city of Philadelphia, have invented certain improvements in the wheels of railroad carriages, by one of which improvements they are made to adapt themselves more readily to curved roads than such as have heretofore been used for that purpose, and by the other, a construction is given to them which will render them more firm and durable than those now in general use, and I do hereby declare that the following is a full and exact description of my said improvements:

The self-adjusting conical wheel for running upon curved roads is well known to engineers, it having been made the subject of a patent by James Wright, and a modified form of it being now used on the Baltimore and Ohio Railroad. The plan which I have devised is a new modification of this principle, by which some of the inconveniences which have hitherto attended its employment are in a great degree, if not altogether obviated. Instead of making the wheel conical on its
172 whole tread, like Wright's, or of forming the conical part against the flanch, and leaving the other part cylindrical, as in those used on the Baltimore road, I form the cone on the outer part of the tread of the wheel, opposite the flanch, leaving that part of the tread which extends from the flanch towards the opposite side, cylindrical, or nearly so, for one-half of its width, more or less, and then tapering outward in

such degree as may be found most convenient, according to the curvature of that part of the road which has the smallest radius. The curved part of the road is adapted to these wheels by widening the track in proportion to the radius of curvature, so as to admit the conical part to roll on the interior rail whilst the cylindrical part bears upon the exterior rail. This construction obviates the objection arising from the wrong tendency of the cone, when running on the exterior rail, and adapts the wheel more perfectly to those parts of the road which are straight, and produces other advantages which will readily occur to experienced engineers.

In order to render railroad wheels more firm and durable than those now in use, I form that part of the wheel usually occupied by the spokes, of two plates of iron, preferring for this purpose thick sheet-iron of three-eighths of an inch, more or less, in thickness. These sheets of iron are raised so as to be concave, or dishing, forming the segment of a large sphere, or if preferred, they may be made conical.

These plates have a hole in their centres to receive the hub or nave, and have a flanch turned up, over which the hoop of the hub may pass, or the hub may be secured in other ways, if preferred. If the rim or tire is of wrought iron, the plates may have a flanch turned at their peripheries, through which they may be riveted on the interior of the rim. When the rim is of cast iron, the plates may be secured without a flanch, one being cast within the rim, against which the plates may fit on either side, rivets or bolts passing through them, and through the flanch, to secure them in their places. Other modes of fixing the plates in their places may be devised, and I do not mean to confine myself to any specific plan of effecting this object, the manner of doing so
173 not in any way affecting the principle upon which my improvement is founded.

What I claim as my invention in my first-described improvement, is making the wheel of a railway carriage conical on its outer edge, and cylindrical between said conical part and the flanch, for the purpose of adapting it to run on curved roads, and applying it thereto upon the principle and in the manner hereinbefore set forth.

What I claim as my invention in my second-described improvement, is the substituting of metallic plates (generally of wrought iron) for the spokes usually employed, and giving to such plates a form which shall be convex, either curved or conical, from the rim to the hub of the wheel.

JOHN ELGAR.

Witnesses—
ROBERT CLARKE.
WILLIAM WALLIS.

EXHIBIT I.—*Dunham's patent, Feb.* 15, 1838.

The schedule referred to in these letters-patent and making part of the same.

To all whom it may concern:

Be it known that I, the undersigned, Henry R. Dunham, of the city, county, and State of New York, engineer and machinist, have invented a new and useful method or improvement in making locomotive engine and railroad car wheels, and I do hereby declare that the following is a full and exact description thereof:

This wheel I cast in an iron mould, and is properly called the chilled

wheel, from the fact of being hardened on the entire periphery, caused by coming in contact with the iron mould at the time of casting
174 it; but instead of continuing the arms of the wheel to the rim, as is now the case, and partly annealing that section of the rim to which it extends, I make two rims, the space between them being two inches, the same can be more or less, and continue the arms of the wheel no further than the inner rim, thereby leaving an uninterrupted space under the outer rim of two inches, more or less, which gives to the outer or chilled rim, an even tempered or chilled surface, (more durable and not liable to flatten, opposite the arm, obviating that difficulty in the wheels now in use,) the outer rim being connected by the sides or edges, to the inner rim, to which the arms of wheel extend. The space between the inside and outside rim is made by the insertion of cores, supported at intervals by cores in the usual manner.

What I claim as my invention or improvement, and desire to secure by letters patent, is the making of two rims, connected at the sides, and leaving an uninterrupted space under the outside rim, excepting where it is joined at the edges or sides of the wheel, and the said vacant uninterrupted space is represented by the drawing herewith sent, and is marked S on said drawing, extending entirely around the circumference of the wheel, between the outer and inner rim; in other words, constituting a hollow felloe, cast in one hollow connected mass entirely around said wheel, and the whole wheel, it may further be remarked, is cast in an entire casting.

In testimony whereof I, the said Henry R. Dunham, have hereunto subscribed my name, in the presence of two witnesses, whose names are also hereunto subscribed, on this eighteenth day of November, A. D. 1837.

HENRY R. DUNHAM.

Witnesses—
SAMUEL A. PORTER.
PHILANDER FISK.

175 EXHIBIT J.—*Bush and Lobdell's patent, March 17th*, 1838.

The schedule referred to in these letters-patent and making part of the same.

To all whom it may concern:

Be it known that we, Jonathan Bonney, Charles Bush, and George G. Lobdell, of Wilmington, in the county of Newcastle, and State of Delaware, have invented an improvement in the manner of constructing cast-iron wheels for cars, to be used upon railroads and for other purposes, and we do hereby declare that the following is a full and exact description thereof:

The accompanying drawing shows a section of our wheel, which, instead of arms, as usually employed, has each face thereof convex, a hollow place being left between the two surfaces. The rim of the wheel A A does not differ from those usually employed, and is cast in a chill in the ordinary manner. The rim is united to the centre or hub of the wheel B B by the two convex face plates C C, which are cast in one piece with the rim and hub. The interior D D, between the two convex face plates, is formed by cores, supported in a way well known to iron founders.

The hub has a transverse division, E E, which separates it into two distinct parts, attached respectively to the two face plates. This divi-

sion is necessary to prevent all the tension which would be produced by shrinkage in the casting, and which would endanger the breaking of the wheel. The hub, if preferred, may be cast solid, with the exception of the division E, and afterwards bored out, or it may be cored and turned to receive the axle.

We are aware that wheels have been made with double convex plates, both of cast and wrought iron, but such plates were in separate pieces from the rims and hubs, being received into rebates on the rims,
176 and embracing the hub between them, which extended through openings in their centres, the two plates being secured together by screw bolts. We are also aware that a plan has been devised for cast-iron wheels with two face plates, having a space between them, formed by cores, as in our method; but the two plates were in this case parallel to each other, one of them being convex and the other concave on its face, the hub extending from one face to the other in a continuous piece, rendering it necessary, on account of shrinkage, to place the two plates as described, an arrangement which sacrificed strength to necessity.

By constructing the wheel so that the plates shall both be convex outwards, as they are in the position of the greatest strength, they may be made considerably thinner than would otherwise be admissible, and the wheel will consequently be lighter.

All that we claim as our invention is the division of the hub into two parts transversely, between two face plates, each convex outwardly, in the manner and for the purpose set forth.

JONATHAN BONNEY.
CHARLES BUSH.
GEORGE G. LOBDELL.

Witnesses:
THOMAS S. MERRITT.
W. MCCAULLEY.

EXHIBIT K.—*Truscott, Wolff & Dougherty's patent, March 17th,* 1838.

The schedule referred to in these letters-patent and making part of the same.

To all whom it may concern:

Be it known that we, Samuel Truscott, George Wolff, and James
177 Dougherty, of the borough of Columbia, in the county of Lancaster, and State of Pennsylvania, have invented a new and improved mode of constructing cast-iron wheels for railroad cars, and for other purposes; and we do hereby declare that the following is a full and exact description thereof:

We denominate our wheel the double-plate car wheel, because we use two plates instead of the spokes or arms usually employed, which plates are cast with the rim, and form one substance therewith. We give to the rim of our wheels the same form, in all respects, as is now given to the rims of car wheels; but instead of arms, we cast our wheels with two parallel, or nearly parallel plates, which plates are convex on one side and concave on the other. The hub or nave, which is to receive the axle, is cast in the center of thin plates, extending from one of them to the other.

The accompanying drawing gives a sectional view of one of our wheels: *a a* being the rim; *b b* the front and back plates, convex on one side and concave on the other; *c c* being the hollow or void space

between them; and *d d* the nave or hub. The hollow *c c* between the two plates is formed by a core in the process of casting, which core is supported in the flask by leaving suitable holes in the plates for that purpose, which holes serve also for the removal of the sand of which the core is formed.

We cast our rim in a chill in the usual manner, and in consequence of the particular form given to the plates they contract in cooling, without danger of fracture, and without its being necessary to divide the hub, as is done when car wheels are cast with spokes or arms.

The only effect of contraction is to flatten the two plates in a slight degree, operating, in this respect, like the curved arms of many cast-iron wheels. We are aware that car wheels have been made with plates as a substitute for arms, but such plates have been made separate from the wheels, and united together by screw bolts, embracing the hub in a distinct piece between them.

The difference between such wheels and those constructed by us is so obvious as not to need pointing out.

178 What we claim as our invention, and wish to secure by letters-patent, is the manner of constructing wheels for railroad cars or for other purposes to which they may be applied, with double-convex plates, one convex outwards and the other inwards, and an undivided hub, the whole cast in one piece, as herein fully set forth.

Columbia, Penn., January 13, 1838.

SAMUEL TRUSCOTT.
GEORGE WOLF.
JAMES DOUGHERTY.

Witnesses:
ALBRIGHT LUNY.
THOMAS LLOYD.

EHHIBIT L.—*Eddy's patent, Dec.* 26, 1845.

The schedule referred to in these letters-patent and making part of the same.

To all persons to whom these presents shall come:

Be it known that I, George W. Eddy, of Waterford, in the county of Saratoga, and State of New York, have invented a new and improved mode of constructing cast-iron wheels for railroads and other purposes, by which the said wheels may be founded or cast without breaking or cracking, or being liable to afterwards break or crack, from strains generated within them while being made or during the act of cooling in the mould; and I do hereby declare that the nature of my invention is fully set forth in the following description, accompanying drawing or drawings, letters, figures, and references thereof. My improvement is applicable to cast-metal wheels alone.

Figure 1 of the said drawings denotes an elevation of the inner
179 side of my improved cast-iron wheel. Figure 2 is a transverse and central section of it; and Figure 3 is another similar section of a wheel, which will be hereafter described.

The said wheel is composed of a cast-iron rim A, and hub B, united together by two plates C D, as seen in Figures 1 and 2. In the above respects the wheel does not differ from many now in common use. My improvement is to be found in the manner in which the plate D is made, the same having an undulating or serpentine shape in cross section, as seen at *a*, *b*, *c*, *d*, *e*, in Figure 2. The plate C, or outer plate of the wheel, is what is termed a convex plate, in contradistinction to a concave plate, which is made dishing towards the centre of the axis of the hub of the

wheels, and when the plate D has been made convex in the opposite direction, it has become necessary in casting the wheels to divide or separate the hub B into two parts, (as will be seen by reference to certain letters-patent, granted on the seventeenth day of March, of the year 1838, to Messrs. Bonney, Bush & Lobdell, of Wilmington, in the State of Delaware;) otherwise the strains upon the hub in opposite directions, caused by shrinkage of the rim in cooling (while being founded) would be so great as to break the hub or plates, or otherwise seriously injure the wheel so as to render it generally unfit for safe usage.

By making either the outer or inner plate of an undulating or irregular shape, as seen in section in Figure 2, and the other plate concave or convex, the former will readily contract in opposite directions, as it cools under the contractile force of the chilled rim, and in so doing will not oppose any counteracting force to that which is generated in a lateral direction by the contraction of the convex or concave plate. Therefore, no separation or division of the hub will become necessary. Consequently I am enabled by thus making the plates of a wheel to render it very much stronger in its hub than when made with two convex plates, whose convexities stand in opposite directions. In connection with the undulating plate D, the other plate C may be made undulating, as seen in figure 3. Both plates, when so made, will readily yield to the contraction of the rim, and will cool without breaking themselves, or either of them, or the hub.

180 Although I obtain a great advantage in being able to cast the hub solid with the exception of the hole which receives the axle, yet I do not intend to confine my invention to the solid hub alone, as by using the undulating plate or plates, even when a divided hub is used, I render the whole much less liable to being fractured or broken when founded than when made with concave plates, or concave and convex plates, or convex plates alone.

I do not claim the manner of constructing a cast-iron or metal railway car wheel by making it of two convex or concave plates, or one convex and one concave plate united to a solid or a divided hub, and a circular rim and flanch, as heretofore made; but that which I do claim is my improved manner of constructing a wheel, by which I am enabled to cast it with a solid hub, and in other respects as I have above set forth, viz, by making it with an undulating plate, in combination with a concave or convex plate, or another undulating plate, as herein described.

In testimony whereof I have hereunto set my signature this twenty-third day of August, A. D. 1845.

GEORGE W. EDDY.

Witnesses:
I. G. SMITH.
D. B. KING.

EXHIBIT M.—*Sizer's specification, April* 17, 1847.

The schedule referred to in these letters-patent and making part of the same.

To all whom it may concern: Be it known that we, George W. Sizer and Henry Sizer, of Springfield, in the county of Hampden, and State of Massachusetts, have invented an improvement in the manner of constructing cast-iron wheels for cars, to be used upon railroads, and

181 for other purposes, and we do hereby declare that the following is a full and exact description thereof. The accompanying drawings show sections of the different combinations of plates, in making

wheels according to our plan. The rim does not differ from those usually employed, and *are* cast in chills, in the ordinary manner. The rim is united to the hub of the wheel, *c c*, by the different plates, as represented in the Figures 1, 2, 3, of the accompanying drawings. Figure 1—the rim and hub are united by the combination of two plates, D D; each concave outwardly from the rim to the hub. Figures 2 and 3—the rim and hub are united by the combination of two plates, D and E, one concave outwardly and the other straight from the rim to the hub, which may be cast either solid or divided, transversely, as wheels heretofore made. Figures 2 and 3 are not claimed. There has always existed a difficulty in manufacturing the different shaped plate wheels heretofore made, on account of the contraction of the two plates towards each other in cooling, thereby pressing upon the core between the plates, rendering it necessary to remove the core from the wheel while hot, or endangering the standing of the wheel. It is a fact well known to iron founders, that iron shrinks in cooling, and if a wheel is made with two plates, each convex outwardly, or one convex outwardly and the other undulated or concave, the plates, as they cool, straighten and contract the space between the plates, and press upon the core. Whereas if the wheel is constructed with two plates, each concave outwardly, the straightening of the plates in cooling, enlarges the space between the plates, thus receding from the core of the wheel, and rendering it unnecessary to remove the core of the wheel while hot, as in other forms. In using one straight and one concave plate, in combination, the space is not enlarged as much, about one-half. It operates on the same principle in cooling, but in a less degree.

What we claim as our invention, and desire to secure by letters-patent, is the casting a car wheel of two plates of metal of the form herein set forth, united to the rim and hub, the respective plates being concave outwards, curving from hub to rim, the object of which
182 form is to cause the plates to contract uniformly, and to enlarge the space between the same at the weakest point as the metal cools, after casting, thereby enabling us to allow the core to remain in the wheel till it becomes perfectly cold. The core remaining in the wheel causes the same to cool slowly, having the effect to anneal and toughen the metal, as is well known to metallurgists.

GEORGE W. SIZER.
HENRY SIZER.

Witnesses:
I. F. HOWLAND,
FREDERICK HANKS.

183 UNITED STATES OF AMERICA,
Eastern District of Pennsylvania:

U. S. circuit court, southern district of Ohio. In equity.

ASA WHITNEY } *vs.* } No. 534.
A. L. MOWRY.

Deposition of a witness examined by consent this eighth day of October, A. D. 1866, before me. Charles Sergeant, special examiner duly appointed herein, at the office of Henry Baldwin, jr., No. 36 South Seventh street, in the city of Philadelphia, the defendant appearing by his counsel, Charles B. Collier, esquire, and the complainant by his counsel, Henry Baldwin, jr.

And EDWARD S. RENWICK, a witness produced on part of the com-

plainant, having first been duly examined, and cautioned and sworn, in answer to the interrogatories propounded to him by complainant's counsel, did depose and say:

Q. 1. State your name, age, residence, and occupation.

A. My name is Edward S. Renwick; I am forty-three years of age; I reside in the city of New York; I am occupied principally in soliciting patents and in acting as expert in the trial of patent causes in the United States courts.

Q. 2. State what have been your opportunities and facilities of acquaintance with improvements and inventions in the useful arts; and if you have had any special familiarity with, or experience in, any branches of iron manufacture, please state that also.

A. For the greater part of the past seventeen years I have been engaged in my present occupation. During that period I have been called upon to prepare a great number of specifications of new inven-
184 tions, and have found it necessary to render myself acquainted with the state of the arts to which they appertain. I have also been called upon to make numerous investigations into the history of the useful arts for the purpose of ascertaining whether patented inventions were new at the dates at which the patents were granted, and for this purpose I have had occasion frequently to examine the official English and French publications of patents granted in England and France, and also to examine such works upon the useful arts as are to be found in the public and private libraries of the city of New York, and the library of the Patent Office at Washington. I have also been frequently called upon to testify in the United States courts as to the similarities and differences of various inventions, and to explain the principles upon which they operated. For about ten years of my life I was engaged in the manufacture of iron, both wrought iron and cast iron, and in the construction of machinery connected therewith. During this period I became familiar with the operations employed in the manufacture, and with the manufacture of castings, and of various articles of wrought iron. During a portion of this time I was engaged in an establishment which had a small foundry connected with it; during another portion of the time I carried on an establishment in which castings were made, and during another portion of the time I carried on a large establishment situated near a foundry, in which I was almost daily, and in which castings for a great variety of purposes, and among others, cast-iron car wheels were manufactured. The period during which I was engaged in the manufacture of iron extended from January, 1840, to April, 1849, and since that period I carried on a blast furnace for the manufacture of iron for about a year.

Q. 3. Have you read an agreed true copy of letters-patent, numbered 5531, and granted by the United States of America to Asa Whitney, April 25, 1848, and do you understand the contents thereof?

A. Yes, sir. I have read the copy referred to in the question, and believe that I understand its contents.

185 Q. 4. What improvement do you find described in that patent?

A. I find described therein an improved process of manufacturing cast-iron railroad wheels. The article upon which the said process is to be performed is described as being railroad wheels cast in the ordinary manner, practised at that time, which consisted in pouring the melted metal into a mould composed in part of cast iron, and in part of sand. The result of which mode of casting was that the exterior rim or tread of the wheel, as it is generally called, was rapidly cooled by the contact of the metal of which it was composed with the iron

portion of the mould, while the remainder of the wheel, the metal of which was in contact with the sand portion of the mould (which is a bad conductor of heat) cooled more slowly. Hence the material in the tread of the wheel was in a highly crystalline and brittle condition, while the remainder of the wheel was in a granular condition, and tough. The difference in the speed with which the two portions were cooled caused the rim of the wheel to contract more rapidly than the remainder; hence, as the wheel cooled it was subjected to strains due to the unequal contraction of its parts, and the result was, that unless a provision was made for permitting these strains to vary the form of the interior, the wheel in cooling was fractured by its own internal strains. The object of Whitney's invention was to neutralise the effect of the strains that occurred in the wheel during the period of cooling down to a temperature at which it could be safely handled, and then to so operate upon the wheel that the various parts of it would be compelled to cool simultaneously, so that no new strains would be caused by the cooling; and that, notwithstanding these operations, the relative conditions of the metal in the different parts of the wheel (namely, the highly crystalline and hard condition of the metal at the rim, and the granular and tough condition of the metal in the plate or spokes and hub) would be unaltered. The process described in the patent consists in operating upon the wheel while it is hot, and
186 before the strains caused by the unequal cooling have produced a material change or fracture of the wheel; in subjecting the hot wheel to a heat progressively increased and controlled until the temperature of all parts of the wheel is raised to the same point, whereby the inherent strains due to the cooling down to the point at which the hot wheel is taken, are retrieved, so that the various parts of the wheel are then in equilibrium; lastly, in regulating the cooling of the wheel from this heated state in such manner that all parts of the wheel are permitted to cool simultaneously, and so slowly that no new strains are produced during such cooling. The patent describes the means which the inventor had devised for applying the regulated heat to the wheels, and for regulating their cooling; such means being a furnace and its appurtenances, consisting of a chamber to contain the wheels, a grate upon which the fuel is burnt, and appendages for controlling the quantity and intensity of the heat. It also describes anthracite coal as the fuel used by the inventor in connection with this furnace; but the patent also describes that fuel other than anthracite may be used, and that the form of the furnace may be varied, so that the improvement described in the patent is not, as I understand it, restricted to the special means described, nor to the particular fuel mentioned.

Whitney's patent.

Q. 5. Have you read an agreed true copy of letters-patent granted by the United States to A. L. Mowry, May 7, 1861, and numbered 1248, (whole number 32252,) and do you understand the improved mode of annealing car wheels described therein?

A. I have read an agreed copy of the letters-patent referred to in the question, and believe that I understand the improved mode of annealing car wheels described therein.

Q. 6. Have you read an agreed true copy of the deposition of Geo. H. Knight, taken on behalf of the complainant in this cause on the 9th and 10th days of April, 1866, and do you understand the mode of annealing car wheels described therein as being practised by the defendant?

187 A. I have read the copy referred to in the question, and believe that I understand the mode therein described, as practised by the defendant.

Q. 7. Please state whether, in your opinion, the improved mode of annealing car wheels set forth in said patent, No. 1248, is substantially the same as, or substantially different from, the process described in the said patent of the complainant, and give your reasons for the conclusion you may express.

A. In my opinion the process of annealing car wheels set forth in said patent, No. 1248, is, in substance, a variation or modification of the process described in the said patent of the complainant, the process in said patent, No. 1248, embodying, in substance, the whole of the process described in said patent of the complainant, and the variation consisting in the use of a particular fuel, (charcoal,) and of a furnace specially adapted to the employment of such fuel for the purpose of increasing the temperature of the wheel. Thus the said patent describes that the article to be operated upon is the same as that described in said complainant's patent; that it is taken in the same condition that it is for the complainant's process, that is, while it is red hot; that it is subjected to a heat which is progressively increased and controlled or regulated until the wheel arrives at the proper temperature, or to use the mode of expression of the said patent, 1248, the wheels are heated up to the proper temperature; lastly, the said patent, 1248, describes that the cooling of the wheel is regulated so slowly that the wheels, when removed from the furnace, are devoid of any strains from unequal contraction. The said patent, 1248, describes that the fuel is applied to the furnace in a manner different from that described in the complainant's patent, namely, that it is stratified with the hot wheels, instead of being applied to the furnace separately from them. It also describes that some air is admitted into the furnace during the cooling, while the complainant's patent describes that the furnace is closed, so that, as a matter of course, air cannot draw into it during cooling. The said patent, 1248, does not describe that the furnace is heated previous to the introduction of the first hot wheel, although the furnace must, of necessity, be heated previous to the introduction of all the other wheels by the burning of the fuel ignited by the first wheel, and subjected to the draught incident to the resting of the fuel upon the perforated bottom or grate, while the complainant's patent describes that the furnace is heated previous to the introduction of the wheels, and, consequently, previous to the introduction of the first one. Although these differences constitute a variation in the mode of practising the process, they do not so change it, in my opinion, as to make it substantially different from the process described as the improvement in the said complainant's patent.

Mowry's patent.

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(Complainant's counsel here produces, and, with consent of defendant's counsel, proposes to use for the purposes of this examination, and at the hearing of this cause, copies written and printed of the several articles or extracts from public works set forth in the answer of the defendant; and, to save the expense attending the production of the works themselves, it is agreed between the parties that said copies (subject to amendment of errors, if any) are true copies, and may be used in this cause the same, and with the same effect as if said publications were themselves put in evidence. Said copies are (briefly) from the Encyclopedia Britannica, seventh edition, 1842, vol. 3, pp. 196, 197; vol. 10, pp. 562 to 579; vol. 12, p. 435. Ure's Dictionary, second edition, 1842, p. 339, p. 582, p. 584, pp. 1177 to 1182. Pilkington's Repository, 1840, pp. 281 and 282. Holtzappfel, 1843, notes on pages 371 and 372, and note F, on p. 462. Lardner's Encyclopedia, vol. 1, 1831, pp. 70, 73, 74, 75, of chapter IV; pp. 300, 301, chapter XIX, and p. 326 of chapter

XX. Franklin Institute Journal, vol. 13, new series, 1834, pp. 150 to 154, and pp. 218, 219; same work, vol. 1, 1826, pp. 224, 225, 226; same work, vol. 4, 1827, p. 45. Cresy's Encyclopedia, vol. 1, 1847, p. 689; extract from Rees's Encyclopedia, as specified in said answer. Mushat on Iron and Steel, 1840, p. 517. Philosophical Transactions, 1840,
189 pp. 503 to 527. Engineer and Machinist's Assistant, 1847, pp. 161, 169. Brande's Dictionary, 1843, p. 54. Prince's Record of Patent Inventions, 1843, p. 139. Cutbush, 1814, (Artists' Manual,) article "Annealing," Gregory, vol. 1, 1815; article "Annealing," Jamieson, 1827, p. 45. Webster's Dictionary, 1828, article "Anneal." Directory, &c., by A. and C. R. Aiken, 1807, vol. 1, pp. 74, 347, 348, and 349. Hebert, vol. 1, 1837, p. 94. Dobson, 1808, vol. 7, p. 783. London Encyclopedia, 1845, pp. 341 and 342; vol. 10, pp. 222 to 237; vol. 20, pp. 757, 758, 759; vol. 21, pp. 721, 722, 723, and pp. 189 to 193. Tredgold, 1842, sect. 1, Introduction, pp. 8 to 11, and it is agreed that said publications are the same as those referred to in the answer of defendant, and the witness is asked as follows:)

Q. 8. Please look at the agreed copies of the references to public works on pp. 8, 9, 10, 11, 12, 13, 14, 15, and 16 of defendant's answer, as printed, and state whether you have read the agreed copies of said publications, and if you understand the contents thereof.

A. I have looked at and read the agreed copies of the publications referred to in the question, and believe that I understand their contents.

Q. 9. Do you find in any one of said extracts a description of the improvement set forth in the complainant's aforesaid letters-patent, No. 5531, and dated April 25th, 1848?

A. I do not find in any one of said extracts a description of the improvement set forth in complainant's said letters-patent. No one of said extracts describes any improvement in the process of manufacturing cast-iron railroad wheels. No one of them describes an annealing process by which the articles operated upon are left with the materials of which they are composed in the same two conditions that the material of cast-iron car wheels is left in after being subjected to the complainant's process; that is to say, with one portion of the material crystalline and brittle, and another portion thereof granular, soft, and tough, and no one describes an annealing process which, if
190 effected, without change, upon cast-iron railroad wheels, would produce the result of the complainant's process.

Q. 10. Please look at the agreed extract from Jamieson's Dictionary, as cited in said answer, and state the reasons of the conclusion you have expressed in view of that particular extract.

A. The said extract describes the annealing of bottles and glass by gradually cooling them, and also the use of a similar process for rendering kettles and vessels of cast iron less brittle, the effect of which process is to convert the cast iron into substantially the same material as forged iron. Neither of these processes, in my opinion, embodies the improvement set forth in the complainant's patent for the following reasons: Neither one is an improvement in the art of manufacturing cast-iron railroad wheels; neither one leaves the material of the article upon which it operates in the same two conditions that the material of
Jamieson's Dictionary. the article subjected to the complainant's process is left in; that is, with one portion of said material crystalline, hard, and brittle, and with the other portion thereof comparatively granular, soft, and tough. On the contrary, the material of the whole of the articles subjected to either of the processes described in said extract

is left uniform throughout. In the process of annealing glass, as described in said extract, the articles to be operated upon are taken in a hot state; but there is no description that they are to be subjected to a regulated heat by which their temperature is raised until all parts are raised to the same point, which is an essential step in the process of the complainant; on the contrary, the articles of glass are described as being gradually cooled from their hottest to their coldest state, the application ot heat in the annealing process being simply for the purpose of delaying the cooling, so that it takes place more gradually than it otherwise would. The process of rendering kettles less brittle is not clearly described in the extract, and there is a doubt in my mind whether the sentence commencing with the words, "and as iron," is intended to be a description of the similar process referred to in the preceding sentence. Whatever it be, there is no description in
191 it that the kettles or other vessels of cast iron are taken from the mould red hot, or as soon after being cast as they are sufficiently cool to be strong enough to be moved with safety, which is an essential operation in practising the complainant's process. Moreover, the said extract does not describe any furnace or means by which cast-iron railroad wheels could be annealed according to the process described in the complainant's patent, nor does it suggest the mode of operation, or the improvement in cast-iron railroad wheels described in complainant's patent.

Q. 11. Please state the reasons for your said opinion with reference to the agreed extract as cited in said answer from Gregory's Dictionary. Gregory's Dictionary.

A. The extract from Gregory's Dictionary describes the same process of annealing glass articles that is described in Jamieson's Dictionary, referred to in my previous answer. It also refers to the process for rendering cast-iron vessels less brittle, but does not describe it, consequently there is no description as respects this latter process, which would enable a person to practise it. My reasons for the opinion I have expressed in relation to the extract referred to in the question are the same as I have given in my previous answer.

Q. 12. Will you please take said agreed extracts other than the two referred to in the last two questions, and give your reasons for the aforesaid opinion expressed by you in reference to said extracts respectively?

A. In the extract from the Encyclopedia Brittan'ica, vol. 3, several processes of annealing are described: the first is the annealing of glass, and consists in placing the articles while hot in an oven or furnace, where they are suffered to cool gradually, the result of which operation is, that all parts of the article are left in the same condition. This process differs substantially from the process described in the complainant's patent in the *the* following respects: it is not an improvement in the art of manufacturing cast-iron rail-
192 road wheels, nor does it suggest any such improvement; on the contrary, by describing in substance that the article is left with the material of which it is composed in the same condition of regular crystallization throughout, it suggests a result which is the reverse of what is required in cast-iron railroad wheels, and, in my opinion, a person who should, prior to the date of the complainant's invention, read such portions of the said extract that relates to the annealing of glass, would be led to think that cast-iron railroad wheels could not be treated by the same process because the result to be attained in them is substantially different from the result that is attained by the annealing of

Encyclopedia Brittan'ica. Vol. 3.

glass in the manner described. Again, the said extract describes that the glass articles are simply suffered to cool gradually, and does not describe or suggest that previous to such cooling they are to be heated to a higher temperature than that at which they enter the annealing furnace, so that the said extract is substantially different in this respect from the process described in complainant's patent. The second process described in the said extract from the Encyclopædia Brittan'ica is for the purpose of softening articles formed of the malleable metals after they have been formed by hammering, and also for softening cast-iron articles which have been rendered hard and brittle by rapid cooling by casting them in wet sand, by which peration, as stated in the said extract, such articles are rendered so brittle as to break by falling on the ground. The process thus described is an annealing process, which consists in slowly raising the articles to a red heat, and then permitting them to cool gradually. There is no statement in said description that any of the articles described in it are to be taken in the hot state in which cast-iron articles are when they have cooled sufficiently to be strong enough to be moved with safety, consequently the second process described in said extract differs substantially from the complainant's process in the absence of either the description or suggestion of the first operation. On the contrary, many of the articles described as subjected to the process are those which are formed in a cold state, and the extract
193 describes in substance the well-known method of annealing metallic articles by taking them after they are cold, heating them to a red heat, and permitting them to cool gradually. Even if cast-iron car wheels could be permitted to become cold before subjecting them to an annealing process, the second process described in the extract could not be used successfully for annealing, because the degree of heat (red heat) which is prescribed in the extract, is insufficient to release the different parts of such wheels from the strains incident to cooling. Consequently the said extract does not afford the information that is required to enable cast-iron car wheels to be annealed successfully, even if the processes could be applied to them.

Encyclopedia Brittan'ica, Vol. 10.

The extract from vol. x of the Encyclopædia Brittan'ica has reference, among other things, to the annealing of glass articles, and my reasons for the opinion I have expressed as respects it are the same as those given by me when speaking upon the glass annealing processes, before alluded to by me.

Encyclopedia Brittan'ica, Vol. 12.

The extract from vol. xii of the Encyclopædia Brittan'ica appears to be a dissertation upon the nature of cast iron, the chilling of castings by casting them in iron moulds, and the conversion of cast iron into wrought iron: no annealing process of any kind is described. The manufacture of cast-iron railroad wheels is not described or suggested, nor any improvement in that art, and the extract has no relevancy upon the question whether the complainant's process was first invented by him or not.

London Encyclopedia.

The extract from the London Encyclopædia describes a process of annealing glass, and also what is termed a similar process for rendering kettles or other vessels of cast-iron less brittle. It also describes a process of annealing specula. The process of annealing glass is the same as that described in the extracts from Jamieson's Dictionary, Gregory's Dictionary, and the Encyclopædia Brittan'ica, before referred to by me, and my reasons for the opinion I have expressed in reference to the description of annealing glass in the London Encyclopædia are the same as those given by me in reference to the three extracts referred to. The process of annealing iron, described in

194 the London Encyclopædia, does not, in my opinion, describe or suggest the improvement set forth in the complainant's patent, for the following reasons: It neither describes nor suggests any improvement in the manufacture of cast-iron car wheels, or of cast-iron articles, portions of which have been chilled by contact with moulds made partly of iron, while the remaining portion are comparatively soft from contact with portions of the mould formed of sand, nor does it describe a process, the result of which is to leave articles having the material in them in two different conditions, in the same two conditions after the process has been performed upon them. It does not describe that cast-iron articles are subjected to the process while taken hot from the moulds before they have cooled sufficiently to be strained by unequal contraction, and therefore does not describe the first essential operation of the complainant's process. All that this portion of the extract describes, as respects annealing, is the operation and effect of exposing cast-iron articles to a high temperature for a different length of time to change their structure throughout, so that, when cooled slowly, they are "found to possess the lamellated structure throughout." The process being in substance one by which cast-iron articles are converted into articles like those of forged iron. Such a change of structure is not contemplated by the improvement described in the complainant's patent, and if it were effected by his process, the article would be rendered useless for the purposes for which it was made.

The portion of the extract which describes the manufacture of a speculum states that the speculum while hot is to be placed in an iron pot with a quantity of hot ashes or small coals, for the purpose of annealing it. There is no statement in this portion of the extract that the heat is to be raised after the speculum is placed in the pot; the extract, therefore, does not describe or suggest the first essential operation of the complainant's process; besides as a pot is a vessel which has no apertures at its sides or bottom to admit air, the coals, if small coals were used, would not be subjected to a draught, which would raise the
195 temperature of the speculum when buried in them as described, and the result would be that the speculum would simply cool down more gradually than it would if left in the sand mould; the idea of raising the temperature at an intermediate point between the casting and the cold state being nowhere suggested; besides, this portion of the extract neither describes the manufacture of cast-iron railroad wheels nor any improvement in such manufacture, nor even the casting of metal in a mould composed partly of iron and partly of sand, and, in my opinion, has no relevancy upon the question of the originality of the complainant's process.

Ure's Dictionary.

The extract from Ure's Dictionary of Arts, Manufactures, and Mines describes a process of annealing glass, a process of annealing articles formed of the malleable metals, a process of rendering cast iron vessels malleable, and a process of making and annealing a speculum, all of which are the same in substance as corresponding processes described in the London Encyclopædia, last referred to, and in the Encyclopædia Britta'nica, vol. iii, and are, in my opinion, substantially different from the process described in the complainant's patent, for the same reasons I have given when speaking of them.

Pilkington's Repository.

The extract from the Artists' and Mechanics' Repository, by Pilkington, describes the softening of cast iron when once hardened, and that for this purpose it must be submitted to complete ignition, and gradually cooled. This extract does not describe or suggest any improvement in the manufacture of cast-iron railroad

wheels; on the contrary, it describes a result (softening) which, if effected upon the said wheels, would render them useless, because such wheels are useful only when their rims are hard. This extract neither describes nor suggests that the cast-iron articles are to be taken from the moulds before they have cooled sufficiently to be materially strained by uneqal contraction; on the contrary, while speaking of the articles as hardened, and by describing the hardening as being effected by the plunging of the article into water, it leaves no other inference than that the articles, before being heated, are perfectly cold. This part of
196 the extract, therefore, does not describe or suggest the first essential operation of the complainant's process, nor any process by which cast-iron railroad wheels could be successfully annealed. The next portion of the extract, under the head of annealing, describes the annealing of glass by a process in which it is permitted to cool gradually, such process being substantially the same as the processes of annealing glass described in the extracts previously referred to by me, and being, in my opinion, substantially different from the complainant's process, for the same reasons that I have previously given in reference to the annealing of glass. This article also describes the annealing of steel and cast-iron articles by a process according to which they are heated to a red heat, and then permitted to cool slowly. No part of this extract describes or suggests the manufacture of cast-iron railroad wheels nor the process of annealing them described in the complainant's patent. There is no description or suggestion that cast-iron articles are to be taken from the moulds at a red heat or before they have cooled sufficiently to be materially strained by unequal contraction; on the contrary, from the statement that the articles are to be heated, and that the heat need not exceed redness, the plain inference to my mind is, that the articles were intended to be taken in a cold state for the performance of the process, as was the well-known practice in annealing iron and steel.

The extract from Holtzapfel's Turning and Mechanical Manipulation describes the manufacture of specula for telescopes. The
Holtzapfel. processes described in this extract are, in my opinion, substantially different from the process described in the complainant's patent, for the following reasons: they do not describe or suggest the manufacture of cast-iron railroad wheels, or any improvement in that art. They describe the manufacture of an article, the material of which is in a highly crystalline condition throughout its whole mass, thus differing from a cast-iron railroad wheel, in which one portion of the material is crystalline, hard, and brittle, while the remainder is comparatively granular, soft, and tough. The extract
197 describes that a speculum may be permitted to contract without fracture, by placing it, while red hot, in ignited wood ashes or any very bad conductor, to delay the cooling, and also that the same effect was obtained with the six-foot speculum of the Earl of Ross by dragging it into an annealing oven and extending the annealing over a period of two months. No portion of this extract describes or suggests the heating of the speculum to a higher temperature than it had when taken from the mould (for the purpose of retrieving the effect of strains incurred in cooling down to the temperature at which the speculum is taken from the mould) previous to permitting it to cool gradually; the extract therefore does not describe or suggest one of the essential operations of the complainant's process. The processes described in the extract are in substance substantially the same as the process of an-

nealing glass by permitting it to cool gradually, and are not applicable to the manufacture of cast-iron railroad wheels.

The extract from Lardner's Encyclopedia, vol. 1, pp. 70 to 75, appears to be a dissertation upon the manufacture of iron, in which, among other things, the mode of annealing metal pots is described. The process, as described, consists in "enclosing the article in a cast-metal pan and covering it therein with coal dust or ashes, so as to exclude the air as much as possible. The whole is then surrounded by fire till the pot is reduced to a sufficient softness, which is generally in about twenty-four hours." No description or suggestion is given of subjecting the articles to this process when taken red hot from the mould, and from the previous portion of the description, the plain inference to my mind is, that the pots are taken for the operation after they have cooled in the moulds and been cleansed of the sand. In another portion of the article the advantage of annealing is spoken of, and also the advantage of subjecting the articles to a heat sufficiently intense to reduce the cohesive power in a very considerable degree; but no suggestion or description is given of taking the articles in a red-hot state for the purpose of subjecting them to such annealing, and a person who followed the description would, in my opinion, operate upon the articles after they had become cold. No portion of this extract describes the manufacture of cast-iron railroad wheels or any improvement therein, nor does any portion of it describe that the article, when annealed, is left with its material in two conditions, as the material is left in a cast-iron railroad wheel after it has been subjected to the complainant's process, nor does any portion of the extract describe or suggest mechanical means which could be used to accomplish the improvement in the manufacture of car wheels described in complainant's patent.

Lardner's Encyclopedia.

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The extract from Lardner's Cabinet Encyclopedia, pp. 300 to 302, describes the annealing of files by heating them and permitting them to cool slowly. No description or suggestion is given that the articles are to be taken for the operation while red hot, after being cast in moulds; on the contrary, files, as we all know, are formed of steel by forging it into shape, and this operation is described in the paragraphs of the the book preceding this extract. There is no suggestion or description in the extract of the manufacture of cast-iron railroad wheels, or of any improvement therein, nor of any cast article of any kind, nor of any article in which the material, after being subjected to the process, is left in two conditions, one portion being crystalline and hard; on the contrary, the object of the operation is stated to be that the steel may be so softened as to admit of being cut with sufficient ease by means of a chisel. Such a result, if attained in a car wheel by the complainant's process, would render the wheel useless. The extract does not describe or suggest any mechanical means by which the improvement in the manufacture of railroad wheels described in the complainant's patent could be accomplished, and, in my opinion, is wholly irrelevant upon the question of the originality of the said invention by the complainant.

The article of Lardner's Encyclopedia, vol. 1, pp. 326, 327, does not describe or suggest any mode of annealing an article of any description, nor does it afford the slightest information on the manufacture of cast-iron railroad wheels. It is, in fact, wholly irrelevant to the question of the originality of the invention set forth in the complainant's patent.

wheels; on the contrary, it describes a result (softening) which, if effected upon the said wheels, would render them useless, because such wheels are useful only when their rims are hard. This extract neither describes nor suggests that the cast-iron articles are to be taken from the moulds before they have cooled sufficiently to be materially strained by unequal contraction; on the contrary, while speaking of the articles as hardened, and by describing the hardening as being effected by the plunging of the article into water, it leaves no other inference than that the articles, before being heated, are perfectly cold. This part of
196 the extract, therefore, does not describe or suggest the first essential operation of the complainant's process, nor any process by which cast-iron railroad wheels could be successfully annealed. The next portion of the extract, under the head of annealing, describes the annealing of glass by a process in which it is permitted to cool gradually, such process being substantially the same as the processes of annealing glass described in the extracts previously referred to by me, and being, in my opinion, substantially different from the complainant's process, for the same reasons that I have previously given in reference to the annealing of glass. This article also describes the annealing of steel and cast-iron articles by a process according to which they are heated to a red heat, and then permitted to cool slowly. No part of this extract describes or suggests the manufacture of cast-iron railroad wheels nor the process of annealing them described in the complainant's patent. There is no description or suggestion that cast-iron articles are to be taken from the moulds at a red heat or before they have cooled sufficiently to be materially strained by unequal contraction; on the contrary, from the statement that the articles are to be heated, and that the heat need not exceed redness, the plain inference to my mind is, that the articles were intended to be taken in a cold state for the performance of the process, as was the well-known practice in annealing iron and steel.

The extract from Holtzapfel's Turning and Mechanical Manipulation describes the manufacture of specula for telescopes. The
Holtzapfel. processes described in this extract are, in my opinion, substantially different from the process described in the complainant's patent, for the following reasons: they do not describe or suggest the manufacture of cast-iron railroad wheels, or any improvement in that art. They describe the manufacture of an article, the material of which is in a highly crystalline condition throughout its whole mass, thus differing from a cast-iron railroad wheel, in which one portion of the material is crystalline, hard, and brittle, while the remainder is comparatively granular, soft, and tough. The extract
197 describes that a speculum may be permitted to contract without fracture, by placing it, while red hot, in ignited wood ashes or any very bad conductor, to delay the cooling, and also that the same effect was obtained with the six-foot speculum of the Earl of Ross by dragging it into an annealing oven and extending the annealing over a period of two months. No portion of this extract describes or suggests the heating of the speculum to a higher temperature than it had when taken from the mould (for the purpose of retrieving the effect of strains incurred in cooling down to the temperature at which the speculum is taken from the mould) previous to permitting it to cool gradually; the extract therefore does not describe or suggest one of the essential operations of the complainant's process. The processes described in the extract are in substance substantially the same as the process of an-

nealing glass by permitting it to cool gradually, and are not applicable to the manufacture of cast-iron railroad wheels.

The extract from Lardner's Encyclopedia, vol. 1, pp. 70 to 75, appears to be a dissertation upon the manufacture of iron, in which, among other things, the mode of annealing metal pots is described. The process, as described, consists in "enclosing the article in a cast-metal pan and covering it therein with coal dust or ashes, so as to exclude the air as much as possible. The whole is then surrounded by fire till the pot is reduced to a sufficient softness, which is generally in about twenty-four hours." No description or suggestion is given of subjecting the articles to this process when taken red hot from the mould, and from the previous portion of the description, the plain inference to my mind is, that the pots are taken for the operation after they have cooled in the moulds and been cleansed of the sand. In another portion of the article the advantage of annealing is spoken of, and also the advantage of subjecting the articles to a heat sufficiently intense to reduce the cohesive power in a very considerable degree; but no suggestion or description is given of taking the articles in a red-hot state for the purpose of subjecting them to such annealing, and a person who followed the description would, in my opinion, operate upon the articles after they had become cold. No portion of this extract describes the manufacture of cast-iron railroad wheels or any improvement therein, nor does any portion of it describe that the article, when annealed, is left with its material in two conditions, as the material is left in a cast-iron railroad wheel after it has been subjected to the complainant's process, nor does any portion of the extract describe or suggest mechanical means which could be used to accomplish the improvement in the manufacture of car wheels described in complainant's patent.

Lardner's Encyclopedia.

198

The extract from Lardner's Cabinet Encyclopedia, pp. 300 to 302, describes the annealing of files by heating them and permitting them to cool slowly. No description or suggestion is given that the articles are to be taken for the operation while red hot, after being cast in moulds; on the contrary, files, as we all know, are formed of steel by forging it into shape, and this operation is described in the paragraphs of the the book preceding this extract. There is no suggestion or description in the extract of the manufacture of cast-iron railroad wheels, or of any improvement therein, nor of any cast article of any kind, nor of any article in which the material, after being subjected to the process, is left in two conditions, one portion being crystalline and hard; on the contrary, the object of the operation is stated to be that the steel may be so softened as to admit of being cut with sufficient ease by means of a chisel. Such a result, if attained in a car wheel by the complainant's process, would render the wheel useless. The extract does not describe or suggest any mechanical means by which the improvement in the manufacture of railroad wheels described in the complainant's patent could be accomplished, and, in my opinion, is wholly irrelevant upon the question of the originality of the said invention by the complainant.

The article of Lardner's Encyclopedia, vol. 1, pp. 326, 327, does not describe or suggest any mode of annealing an article of any description, nor does it afford the slightest information on the manufacture of cast-iron railroad wheels. It is, in fact, wholly irrelevant to the question of the originality of the invention set forth in the complainant's patent.

199 Franklin Journal, vol. 13. The extract from the Journal of the Franklin Institute, vol. 13, pp. 150 to 154, is a dissertation upon the nature of cast iron, in which, among other things, reference is made to a mode of softening hard cast iron by annealing it in sugar; there is also a statement that iron, hard from being chilled, "may be softened by a simple annealing," by which I understand the ordinary annealing process, which consists in subjecting the articles after they are cold, to a red heat, and then permitting them to cool slowly, while the access of air is prevented either by packing the articles in charcoal dust, or by placing them in a furnace which can be tightly closed. No part of this long extract describes or suggests the manufacture of cast-iron railroad wheels, nor the process described in the complainant's patent. No part of it describes or suggests that cast-iron articles of any kind are to be taken red hot from the mould before they have cooled sufficiently to be injured by internal strain, for the purpose of annealing them, or for the purpose of raising them to a higher temperature, in order that the strain incident to unequal contraction may be relieved. Moreover, the extract does not describe or suggest any mechanical means which could be used for accomplishing the improvement described in the complainant's patent.

The extract from the Franklin Institute Journal, vol xiii. pp. 218 and 219, describes a mode of softening hard cast iron by first heating it, then washing it with a solution of pearl-ash, and subsequently placing it again in the fire and allowing it to remain until very hot, after which it is suffered to cool. It also refers to previous modes of softening hard cast iron by the aid of brown sugar, soap, lime, &c., but does not describe those modes; this extract describes that the article upon which the operation was performed was in a cold state, because it speaks of trying its hardness by a cast-steel drill, which would have been done only when the article was cold. It also describes that the article was first heated so that it was scarcely red, which is another indication that the article before such heating was cold, and it describes that the same process was practised upon various other castings. There is no in-
200 dication or suggestion in this extract that the purpose or effect of the process was to relieve the article of strains caused by unequal contraction, nor to leave a portion of the article crystalline and hard; on the contrary, the purpose and effect was to soften the article. There is no description or suggestion in the extract of the manufacture of cast-iron railroad wheels, or of any improvement in such manufacture, nor is there any description or suggestion in said extract of any mechanical means by which the improvement in the manufacture of cast-iron railrood wheels, described in the complainant's patent, could be practised.

(Here, by agreement between the parties, the continuation of the examination of this witness is adjourned to Tuesday morning, the 9th instant, at 9 o'clock; the time for taking testimony being extended accordingly, but only for the purpose of concluding the examination of this witness, and not for any other or further examination.)

And now, October 9th, 1866, at 9 o'clock, a. m., met pursuant to adjournment, and the witness resumed:

Franklin Journal, vol. 1. The article from the Franklin Institute Journal, vol. i., pp. 224 to 226, is a treatise on various subjects, namely, on the use of chilled cast iron for punches and other tools; on forming cutting tools of cast steel as hard and tough as possible; on hardening articles made of steel wire without bending them; on an improved method of

softening or annealing cast steel by carefully "heating the steel nearly to the hardening point, and instantly quenching or cooling it in water;" and lastly, on welding cast steel and cast iron. No one of the descriptions under these several heads affords the slightest information on the manufacture of cast-iron railroad wheels, or any annealing process in which the articles operated upon are gradually cooled; the only annealing operation that is described being one in which the articles are instantly cooled by throwing them while hot into water; in my opinion this extract has no relevancy to the subject of the complainant's process.

201 The extract from the Franklin Journal, vol. iv., p. 45, describes the annealing of steel by heating to a red heat in close vessels, and letting it cool very slowly; no description or suggestion is given of the operation of taking the steel in a hot state from casting before subjecting it to the process. The process obviously has reference to the annealing of articles which have been formed by forging or rolling. The extract does not describe or suggest the manufacture of cast-iron railroad wheels or any improvement thereon; and, in my opinion, has no relevancy to the subject of the improvement described in the complainant's patent.

Franklin Journal vol. 4.

The extract from the Franklin Institute Journal, vol. iv., pp. 45 and 46, describes the process of annealing iron and steel wire in different countries; the wire, after being drawn, is described as being placed in close vessels, which are heated in a furnace, and then permitted to cool slowly. As all wire is drawn cold, the wire, before being subjected to the process, must of necessity have been in a cold state. The extract does not afford the slightest information or suggestion upon the manufacture of cast-iron railroad wheels, and, in my opinion, has no relevancy to the subject of the improvement described in the complainant's patent.

The extract from Cresy's Encyclopædia of Civil Engineering, vol. i., p. 689, describes the manufacture of dry sand castings in which the moulds are baked until they are perfectly dry before the metal is poured into them. The extract does not describe or suggest a process of annealing the castings made in such moulds, or in any other manner, and, in my opinion, has no relevancy to the subject of the improvement described in the complainant's patent.

Cresy's Encyclopedia.

The extract from the Cyclopædia, or Universal Dictionary of Rees, describes the manufacture of cutlery and other articles of what is now termed malleable iron. According to this system of manufacture, the articles are first formed by casting. After they are taken from the mould, they "are cemented with ashes or sand, for the purpose of annealing them;" or, according to a subsequent

Rees' Encyclopædia.

202 improvement, are stratified with calcined pulverized iron-stone (iron ore) or similar material containing oxide of iron, which, when heated in contact with the cast iron, furnishes oxygen which combines with the carbon of the cast iron. No description or suggestion is given of taking the articles from the moulds before they have cooled, and according to the usual mode of practising the process, the articles are permitted to cool, and are cleansed from the sand before they are subjected to the process, and are placed in the pots by hand. The extract does not afford the slightest information upon the subject of the manufacture of cast-iron railroad wheels, and the result of the process is to reduce all parts of the castings to a uniformly soft condition; the articles, as the extract states, being "found, after this process, to have become very soft, and to be capable of bending a little without breaking;" which is a result the reverse of what is required and obtained in the

manufacture of cast-iron railroad wheels, in which the portions which are made hard by the system of casting in a chill, retain their hardness when the wheel is completed for use. And, in my opinion, the extract has no relevancy to the subject of the improvement described in complainant's patent.

The extract from Mushat on Iron and Steel, pp. 516 to 518, describes the effect of the cementing process upon white cast iron and bar iron.

Mushat.

The process consists in heating the articles in contact with charcoal and without access of air, and is the common process practised in converting iron into steel. The result of the process, when performed upon white cast iron, is stated to be that "it acquires a soft grey fracture, easily reducible by the file," which is a result the reverse of what is required in the manufacture of cast-iron railroad wheels, in which the crystalline white portion at the tread of the wheel must retain its hardness after the wheel is completed for use. The extract does not describe or suggest the manufacture of cast-iron railroad wheels, or any improvement thereon, or any mechanical means by which such manufacture could be practised. It does not describe or suggest that the cast-iron articles are to be taken hot from the mould before they are
203 subjected to the cementing process. On the contrary, the plain inference from the description is that the articles are treated in the ordinary way practised in cementing, in which the articles are always taken in a cold state for the performance of the process. In my opinion, the extract has no relevancy to the subject of the improvement described in the complainant's patent.

The extract from the Philosophical Transactions, for the year 1840, Part II, pp. 503 to 527, describes the series of experiments made in the manufacture of telescopes by Lord Oxmantown, and, among other things, describes the manufacture of specula for telescopes. The extract describes the operations of casting and annealing a speculum. The extract describes that the casting was performed in a mould composed in part of metal and in part of sand; also, that the casting, while "still red hot," was drawn from the mould into "the hot oven," and permitted to cool slowly. In a preceding part of the description, it is stated the oven is to be "heated a little below redness," so that the oven was, if anything, cooler than the speculum, which, as before stated, was "red hot" before it was drawn into the oven. No description or suggestion is given of increasing the temperasure of the speculum after it was placed in the oven. On the contrary, the description is that it was simply to remain in the oven until it was cold; so that the idea of heating the casting after its removal from the mould up to a point at which the various parts of it should be of uniform temperature, which is an essential part of the process described in the complainant's patent, is nowhere indicated or suggested in the extract. The extract does not describe or afford any information upon the manufacture of cast-iron railroad wheels, nor does it describe or suggest the use of any means by which the temperature of the oven employed could be raised after the speculum was placed in it.

Philosophical Transactions.

Tredgold.

The extract from the "Practical Essay on the Strength of Cast Iron," by Tredgold, refers, among other things, to the improvement in cast iron by annealing, but does not describe the mode of conducting the process or the means employed, as I understand
204 the description. It refers to two modes of annealing: one in which the iron is permitted to pass slowly to the solid state, or, as stated in another part of the extract, to cool slowly; the other mode referred to is, as I understand it, the ordinary process of annealing

metals, in which the articles, after they have attained a cold state, are reheated and cooled slowly. There is no description or suggestion in the extract that the articles are to be taken hot from the moulds and heated up to a point at which their several parts become of uniform temperature before they are permitted to cool. The extract does not describe or suggest the manufacture of cast-iron railroad wheels, or any mechanical means by which such manufacture could be effected, nor does it describe or suggest the manufacture of any cast iron articles by casting them in moulds composed in part of iron and in part of sand.

The extract from the Engineers' and Machinists' Assistant, Part II, p. 161, refers to a mode of making the hard portions of an iron casting soft by exposing it for many hours to an intense heat, with free access of air. The hard portions referred to, are those hardened by contact with the moist sand of which the mould is formed, and which were "intended to be soft." There is no description or suggestion in this extract that the articles are to be taken from the moulds before they have become cold for the purpose of being subjected to the heating which is essential in conducting the process described in complainant's patent. Moreover, the article does not describe or suggest the manufacture of cast iron railroad wheels. Engineers' and Machinists' Assistant.

The second extract from the same work, p. 169, describes, among other things, the effect of heating steel in a current of air, and of heating it while wrapped up in a cementing mixture, or in a fire containing animal coal, put together so as to operate in the manner of a cementing mixture. It also describes the effect of the sudden immersion of steel articles, while hot, in water. This extract does not describe or suggest the taking of articles while hot, from moulds, and then heating them to a higher temperature, which is an essential characteristic of the
205 improvement described in the complainant's patent; it does not describe or suggest the manufacture of cast-iron railroad wheels, nor any mechanical means by which such manufacture could be effected.

The extract from the Dictionary of Science, Literature, and Art, by Brande, refers to the annealing of glass, by suffering it to cool very gradually, and to the annealing of metals which have become harsh and hard in the process of manufacture, giving as instances the blank pieces for coinage and metallic wires, all of which are formed by operating upon the metal in a cold state, so that the articles are necessarily cold before they are annealed. The annealing of glass referred to, is the same process as that described in preceding extracts to which I have referred, and the reasons for the opinions I have expressed in reference to this portion of the extract, are the same as those I have given in reference to the preceding extracts describing the annealing of glass. The annealing of metals referred to, is the same as the annealing described in the extract from the Franklin Journal, vol. iv, pp. 45 and 46, and my reasons for the opinion I have expressed in reference to this portion of the present extract are the same as I expressed when speaking of the said extract in the Franklin Journal. I may state, in addition, that the present extract (from Brande) does not describe or suggest the employment of any mechanical means by which the operations referred to in it could be effected, and, in my opinion, has no relevancy to the subject of the improvement described in the complainant's patent. Brande's Dictionary

The specification of Jessop's English patent describes a process of hardening the surfaces of wheel tires, produced by rolling, and conse-

Jessop's patent. quently made of wrought iron. The process consists in cementing them in charcoal or carbonizing fuel in an ordinary converting furnace, and in afterwards rerolling, hammering, or swaging them for the purpose of smoothing down the blisters produced by the cementing operation. The specification affords no information or suggestion upon the manufacture of cast-iron railroad wheels, or of cast-iron articles of any kind. The furnace referred to, is the ordinary cementing furnace for converting wrought iron into steel, in which the wrought iron is packed in charcoal powder, or rather carbonizing mixture, in close chambers formed of fire brick, from which the air is excluded, and which are heated on their outer sides; and there is no description or suggestion that the articles are placed in the furnace in any other than the ordinary manner; that is, when they are cold. In my opinion, the said specification has no relevancy to the subject of the improvement in the manufacture of cast-iron railroad wheels described in the complainant's patent.

Prince's Record of Patented Inventions.

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Cutbush's Manual. The extract from the American Artists' Manual, by Cutbush, refers to the ordinary processes of annealing metals and glass, and to a process of rendering kettles and other cast-iron vessels less brittle, but does not describe or suggest any means by which such processes could be practised. The processes referred to are the same as those described in previous extracts referred to by me, describing the annealing of glass, speculum metal, and wire, and also the process of rendering kettles less brittle by heating them in a furnace; and the reasons for the opinion I have expressed in reference to this extract are the same as those given by me when speaking of extracts referring to the same subjects.

Webster's Dictionary. The extract in the American Dictionary, by Webster, are definitions of the word "anneal," and do not afford any information upon the manufacture of cast-iron car wheels; they refer to the ordinary processes of annealing glass and metals which have been described in previous extracts, and my reasons for the opinion I have expressed in reference to this extract, are the same as those given by me when speaking of previous extracts describing the same processes.

The extracts from the Dictionary of Chemistry and Mineralogy, by Aiken, vol. 1, p. 74, describes in general terms the annealing of articles by permitting them to cool slowly and equally, and refers, as instances to the annealing of glass, speculum metal, and beaten gold. The last of which is beaten in a cold state, and is annealed in substantially the same manner as wire, the annealing of which is fully described in a previous extract referred to by me. The reasons for the opinion I have expressed in reference to this extract, are the same as those given by me when speaking of the descriptions in previous extracts of the annealing of glass, speculum metal, and wire.

Aiken's Dictionary.

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The extract from the Dictionary of Chemistry and Mineralogy, by Aiken, vol. 1, pp. 347 to 349, appears to be a dissertation upon the alloys of copper, and describes, among other things, the annealing of a cast speculum by laying it while red hot in a pot full of very hot embers, and permitting it to cool very slowly. This extract does not describe nor suggest the heating of the speculum to a higher temperature than it is at when put into the pot before permitting it to cool. On the contrary, as embers are a mixture of ashes and small coals, which will not burn when placed in a pot, the plain inference is, that the object of the process is as stated, simply to permit the red-hot speculum to cool slowly.

This extract neither describes nor suggests the manufacture of cast iron railroad wheels, nor any improvement therein, nor any means by which such manufacture could be effected, and, in my opinion, has no relevancy to the subject of the improvement described in the complainant's patent.

The extract from the Engineers and Mechanics' Encyclopedia, by Hebert, p. 54, is a general definition of the process of annealing. It refers to the annealing of glass, and to the annealing of steel and iron, by heating them to a low redness, and suffering them to cool gradually. The annealing of glass referred to is probably the same as that described in previous extracts, and my reasons for the opinion I have expressed in reference to this portion of the present extract are the same as those I have given when speaking of the annealing of glass, as described in previous extracts. The annealing of metals referred to is evidently the same process as that described in the Franklin Journal, vol. 4, pp. 45 and 46, for annealing wire, and my reasons for the opinion I have expressed in reference to this portion of the present extract are the same as those I have given when speaking of the said extract in the Franklin Journal. Hebert's Encyclopedia.

208 The extract from the Encyclopedia, by Dobson, vol. 7, p. 783, describes the processes of coloring glass, and manufacturing glazing. It does not describe or suggest any annealing process, in my opinion, and has no relevancy to the subject of the improvement described in the complainant's patent. Dobson's Encyclopedia.

Cross-examined by Mr. Collier:

Q. 1. The first step in the process described in the complainant's patent consists in taking railroad wheels from the moulds while in a hot state, does it not?

A. That is a general statement of the first operation, but the hot state referred to is described in the patent as being one in which the cast wheels have not so much cooled as to produce such internal strain on any part, as to impair their ultimate strength. This operation also includes, as I understand it, the formation of the wheel, by casting it in the ordinary manner, that is, in a mould composed partly of iron and partly of sand, by the operation of which the bad effect is produced which it is the object of the latter portion of the process to obviate or retrieve.

Q. 2. Is there any direction in the letters-patent indicating the degree of heat or temperature at which the wheel should be removed from the mould?

A. There is.

Q. 3. Will you specify the language in the patent indicating such degree of temperature?

A. The language used is as follows: "As soon after being cast as they are sufficiently cool to be strong enough to be moved with safety, or before they have become so much cooled as to produce any considerable inherent strain between the thin and thick parts." The first portion of this extract, when taken in connection with the previous state of the art of manufacturing cast-iron railroad wheels, in which they were taken from the moulds as soon after being cast as they were sufficiently cool to be strong enough to be moved with safety, which was at a high red heat, prescribes that in practising the complainant's

209 process the wheel should be taken from the mould at a high red heat. The latter part of the quotation, as I understand it, is a direction that the wheels may be taken from the moulds when they have cooled down below the high red heat referred to in the previous

sentence, provided they have not become so much cooled as to produce any considerable inherent strain between the thin and thick parts.

Q. 4 Do you mean to be understood as inferring from the patent, that when the wheels are sufficiently cool to be strong enough to be moved with safety, no considerable inherent strain has been occasioned?

A. I do; but by the words considerable inherent strain, I understand such a strain as would impair the wheel so that it could not be ultimately restored to its strength by the performance of the subsequent operations upon it.

Q. 5. The next step in the process described in the complainant's patent, is putting the wheels in this state into a furnace that has been previously heated to a temperature as high as that of the wheels when taken from the moulds, is it not?

A. That is so described in one part of the specification, but in another part of it the description is that the wheels are to be deposited in a previously-heated furnace or chamber without stating that it is to be heated to a temperature as high as that of the wheels when taken from the moulds, and, in my opinion, if the furnace were not previously heated to as high a temperature as that of the wheels when taken from the moulds such a variation in the mode of practising the process would not, in my opinion, substantially change it, provided the wheels were not so cooled down by being placed in such a furnace that their ultimate strength was impaired by the inherent strain produced. (So much of the answer as follows the word "moulds," objected to by the defendant's counsel as not being responsive to the question.)

210 Q. 6. In your opinion, in the practise of the complainant's patented process, is it essential or non-essential, important or unimportant, that the furnace should be heated to a temperature as high as that of the wheels when taken from the moulds at the time the wheels are placed in such furnace?

A. As I understand the invention it is not essential that the furnace should be heated to a temperature as high as that of the wheels when taken from the mould, but it is important and desirable, because if the furnace be so heated there is no risk of producing strains that would impair the ultimate strength of the wheel.

Q. 7. Is it essential, in your opinion, in the practice of the complainant's process, that the furnace should be heated at all at the time when the wheels are deposited in it?

A. According to the description in the specification of the patent, I think that it is.

Q. 8. Upon the hypothesis that the heat was introduced into the annealing furnace from the fire chamber at the time the wheels were placed in the furnace, and not before, would, in your opinion, the process be substantially the same as that described in the patent?

A. It would, provided the operation was so conducted that after the introduction of the wheels they were heated up, or their temperature raised until all parts of each wheel were raised to the same temperature, and afterwards the wheels were permitted to cool so slowly that all parts of each wheel would shrink simultaneously together. I assume, of course, that the wheels are taken hot from the moulds before their introduction into the chamber, substantially as set forth in the complainant's patent.

Q. 9. Why then do you state, in answer to cross-question 7, that it is essential, in your opinion, in the practice of the complainant's process, that the furnace should be heated at all at the time the wheels are placed in it?

211 A. Because, as I understand the specification, it is made essential, and because if the heat and the wheels be introduced at the same time, the furnace is of necessity hot, by the terms of the statement, at the time the wheels are introduced; and because, as the heat must be necessarily introduced, according to the statement in the eighth cross-question, at the time the first wheel is inserted, the furnace is necessarily heated before the succeeding wheels are inserted.

Q. 10. Is the degree of heat that shall be introduced at the instant of the introduction of the wheels into the furnace in order to make such process substantially similar to that described in complainant's patent, a circumstance of importance?

A. In my opinion, the temperature of the heating medium that is introduced into the furnace, must be such that the wheels are not cooled down by immersion in it, to a point at which the inherent strains produced by cooling would impair their ultimate strength.

Q. 11. What point would that be?

A. It would vary in different wheels, according to their peculiar form and the distribution of metal in them. I have never experimented upon wheels for the purpose of ascertaining the lowest temperature to which they could be cooled without producing such strain, and am therefore not able to state what that exact temperature is.

Q. 12. Do you consider it essential, in the practice of the complainant's process, that the wheels should not be suffered to lose heat at and from the time they are placed in the annealing furnace?

A. I do not, provided they are not cooled down by such loss to a point at which the inherent strains have impaired their ultimate strength. For example, suppose that the wheels might be cooled down, without impairing their ultimate strength, to what is commonly
212 called "a black red heat," which is one in which they first appear to be red in the dark, and that they are placed in the annealing furnace at a high red heat, it is clear that they might cool down in the furnace from the bright red heat to the black red heat without ultimate injury, provided they were subsequently heated up and cooled gradually, as described in the complainant's patent.

Q. 13. When, in the casting of car wheels, cast in moulds composed in part of sand and in part of iron, does the inherent strain in the cast metal commence?

A. It must commence the moment the melted metal congeals, and goes on increasing in intensity until the metal is practically cold, or until fracture has taken place, which fracture relieves the strain in whole or in part.

Q. 14. The next step in the process of the complainant, as described in his letters-patent, after the wheels deposited in the furnace and the opening through which they have been passed is closed, is raising the temperature of the furnace, and the wheels gradually to a point a little below that at which fusion commences, is it not?

A. The mode of practising the process described by the complainant, is to raise the temperature of the furnace and wheels as stated in the question, but I do not understand that the specification restricts the temperature to which the wheels are raised to a point a little below fusion, but that that temperature is one at which the effect which he desires to obtain by the increase of temperature will be attained. The temperature must be such, as stated in another part of the patent, that all parts of the wheel may be raised to the same point.

Q. 15. What, as a scientific man, do you understand by the words in the patent, "Say a little below that at which fusion commences?"

A. I understand a temperature a little below that at which the materials of the wheels would begin to melt; the expression conveys
213 to my mind the idea that it is the highest temperature to which the wheels might be raised without risk of melting them, or a heat below that at which the wheels would become distorted by the iron changing its shape by a loss of its cohesive power.

Q. 16. When the plates of the wheel approximated the point of fusion, would the hubs and treads of the wheel be at a higher or a lower temperature than the plates?

A. The thinner parts of the wheel would be at a higher temperature than the hubs, which are the thicker parts, or at the same temperature, according to the mode in which the heat was applied. The thicker portions of a casting absorb heat more slowly than the thinner parts; consequently if the heat were applied more rapidly than the thick portions took it up, the thinner portions would approximate to the point of fusion more rapidly than the hub; but if the heat were applied gradually, so that the heating of the thicker portion kept pace with the heating of the thinner portions there would be no material difference in the heat of the parts of the wheel at the time the highest temperature was reached.

Q. 17. If the heat in Whitney's process was introduced at the instant of introducing the wheels into the furnace, would the temperature of the hubs and treads of the wheels be greater or less than the temperature of the plates when the temperature of the latter was a little below that at which fusion would commence?

A. The temperature of the different parts of the wheel would be substantially the same when the plates arrive at a point a little below that at which fusion would commence, because the heat in the Whitney process would be raised gradually.

Q. 18. State what manner of introducing or applying the heat to the wheels would result in their respective parts being unequally affected by it.

A. I think that if a wheel were placed in a highly-heated rever-
214 beratory furnace, such, for example, as that used for melting the iron for guns, or in heating iron for rolling, the furnace being heated up to the melting point of iron at the time the wheel was introduced, the parts of the wheel would be so unequally affected that the thinner portions would begin to melt before the hub attained a temperature a little below that of fusion.

Q. 19. Would not, in any furnace, whatever its form, into which the wheels might be placed, if the same degree of heat came in contact in the same manner with all parts of the wheels, necessitate the heating of the thinner parts of the wheel more rapidly than the thicker parts?

A. I suppose, theoretically, the thinner parts should heat faster than the thick parts, but practically, I don't believe there could be any material difference, unless the heat was increased too rapidly.

Q. 20. This being as you have stated, would not the application of fuel directly to the plates of a wheel, and not in its other parts, cause the heat of the plates to be increased more rapidly than that of the thicker parts in a practical sense, the operation being supposed to be conducted in a furnace such as described by Mr. Whitney, or in any furnace where air was admitted to support combustion?

A. If the operation were performed in a furnace, such as described by Mr. Whitney in his patent, with coal burnt upon the grate, and, in addition with fuel placed in contact with the plates of the wheels, which I understand to be the hypothesis in the first part of the ques-

tion, I don't believe that the heat of the plates would, in a practical sense, be increased more rapidly than the heat of the thicker parts, unless the fuel, so placed in contact with the plates, was charcoal, and the fire upon the grate was permitted to die out as the wheels were introduced, in which case the presumption would be that the current of air entering through the grate, and passing around the exterior of the wheels, would keep the rims from raising in temperature as rapidly
215 as the plates, which were in immediate contact with the burning charcoal. The latter part of the question is too indefinite for me to answer, as the character of the furnace would effect the result, and therefore I should know the character before answering.

Q. 21. Do you give this opinion positively, or as matter of impression?

A. I give it as the result of reasoning upon the subject. I have never made the experiment, and therefore cannot state what would be the positive result.

Q. 22. Would the opinion, which you have expressed in your examination-in-chief, as to the effect of Mowry's process and its alleged identity with Whitney's process, be modified if you were advised that in practising his process Mowry applies his charcoal only to the plates of the wheels?

A. If that were the only change my opinion would not be modified, because the construction of the furnace described in the Mowry patent is such that the heated atmosphere produced by the burning of the charcoal is confined closely to the rims of the wheels, and in practising the process, as described in the Mowry patent, I have no doubt that there would be no material difference in the temperature of the several parts of the wheel when the highest temperature was reached.

Q. 23. What, in your opinion, would be the effect upon the chill of the wheel if all parts of it were raised to a temperature, say a little below that at which fusion commences?

A. If the temperature after being so raised was then lowered I do not think there would be such a change in the chill as to affect its value for practical use, but if the temperature were maintained at that point for a considerable space of time the hardness produced by chilling might be materially affected; and I have no doubt it would be materially affected if, at the same time, air containing free oxygen were permitted to act upon it, as chilled iron under such circumstances changes its character, by the burning out of the carbon contained in it.

216 Q. 24. Are the words, "say a little below that at which fusion commences," in your opinion, synonymous with the words, "in a state approaching to fluidity?"

A. If they are both used in connection with the same material I should say that they meant substantially the same thing; but if one has reference to the fusing point of iron, and the other has reference to the fusing point of a material which melts at a different temperature from iron; the two expressions would not indicate the same temperature, or be synonymous.

Q. 25. In the article referred to, in the defendant's answer. from the Dictionary of Mechanical Science, by Alex. Jamieson, these words occur, "Annealing, nealing, the cooling of bottles and glass gradually by placing the materials thus blown in a furnace in which they gradually cool." Do you infer from those words that the articles referred to therein are placed in the annealing furnace in a hot state, or otherwise?

A. I infer that they are placed in the annealing furnace in the hot state in which they are when they are formed.

Q. 26. In the article referred to, in the same connection, occur the following words, "By the process of annealing the glass is kept for some time in a state approaching to fluidity." Do you infer from that that heat is applied to the annealing furnace, and that the temperature of the articles introduced into it is raised subsequent to their introduction?

A. I do not. I infer that the temperature of the annealing furnace is at its highest point when the articles are introduced into it, and that neither its temperature, nor that of the articles is raised after such introduction, and that the temperature is maintained for sometime at the same point.

Q. 27. In the article referred to, in defendant's answer, from a work entitled "A New and Complete Dictionary of Arts and Sciences," by Gregory, occur the following words, "Annealing or nealing is a process particularly employed in the glass-houses, and consists in putting
217 the glass vessels as soon as they are formed, and while they are yet hot, into a furnace or oven, not so hot as to remelt them, and in which they are suffered to cool gradually." What is your inference from this paragraph as to the temperature of the articles being increased after they are put into the annealing oven, or otherwise?

A. My inference is that the temperature of the articles after they are introduced into the annealing oven is not increased; but, on the contrary, that the cooling goes on, but gradually as compared with the speed at which cooling would take place if the articles were permitted to cool in the open air.

Q. 28. Is your opinion, as expressed in your examination-in-chief, that this process as applied to glass is substantially unlike Whitney's process as applied to car wheels predicated upon the interpretation which you have given to the extract last referred to, in whole or in part?

A. That is one of the reasons for the opinion that I expressed.

Q. 29. If you are in error in supposing that the temperature of the articles annealed according to the process described by Gregory is not raised after their introduction into the annealing furnace, would such process as applied to glass be substantially like or unlike that of Whitney as applied to car wheels?

A. It would still be substantially unlike the improvement described in the complainant's patent, for the reason that the first operation, which constitutes a part of the complainant's process, and which is set forth in my answer to the first cross-interrogatory, is not described, and could not be inferred from the language in Gregory; also because the process in Gregory is an improvement in a different art, and because the heat that is prescribed in Gregory is much lower than that required in practising the Whitney process, and because the description in Gregory gives no information as to any mechanical means by which the improvement described in the complainant's patent could be practised.

218 Q. 30. The first operation, as described by Gregory, is the removal of the articles to the annealing furnace "as soon as they are formed, and while they are yet hot." The first operation in the complainant's process consists "in taking the wheels from the moulds in which they are ordinarily cast, as soon after cast as they are sufficiently cool to be strong enough to be moved with safety." State precisely wherein these operations differ from each other.

A. They differ in the respect that the mode of forming the articles, which constitutes a part of the operation in each case, is substantially different. The glass vessels are formed by blowing, or by pressing the plastic glass into moulds composed in whole of metal, and the nature of the material operated upon is such that the effect produced by casting

iron in a mould composed in part of metal and in part of sand, is not produced. The cast-iron railroad wheels are formed by pouring the metal in a fluid state into a mould composed in part of iron and in part of sand, the effect of which is to harden the portion that comes in contact with the iron while the remainder becomes comparatively soft. The former operation is analogous to the formation of wrought-iron articles by pressing the iron while hot in iron moulds, but has no analogy to the casting of metal in a fluid state in a mould composed in part of metal and in part of sand.

Q. 31. State wherein they differ, if at all, in temperature at the time of their removal respectively to the annealing furnaces?

A. I have never compared the temperature at which glass vessels are placed in an annealing oven with the lowest temperature at which wheels might be taken from the mould in practising the complainant's invention, although I have noticed that the iron pans, wheels, and rails which are used in annealing ovens for annealing glass vessels are not materially affected by the heat for a long period; there is, therefore, a question in my mind whether the temperature at which articles are placed in an annealing oven might not be so low that wheels, if permitted to cool down to it, would have their ultimate strength impaired by
219 the inherent strain, still it is possible that such might not be the case; and if it be so, then the temperature of the glass and the car wheel may be the same at the time of removal to the respective furnaces.

Q. 32. In the article from Gregory referred to, after describing the process of annealing glass, the following words occur: "A similar process is used for rendering cast-iron vessels less brittle" upon the hypothesis that the "similar" process referred to consists in putting the cast-iron vessels "as soon as they are formed, and while they are yet hot, into a furnace or oven not so hot as to remelt them, and in which they are suffered to cool gradually." State whether such operation is not identical with that of Mr. Whitney.

A. It is not, for the reason that the language used affords no suggestion or description of the raising of the temperature of the articles after they are placed in the oven, and for the further reason that it neither describes nor suggests that the cast-iron vessels are made in the manner of railroad wheels by casting them in a mould composed in part of iron and in part of sand, while, as all founders know, cast-iron vessels are not formed in that manner, and could not be, for the reason that the thinness of such vessels is such, and the quantity of metal so small, in comparison with the size, that the metal entering the mould would be chilled and congealed before it reached the parts for which it was intended, and perfect castings could not be made. Also for the further reason that it does not describe or suggest any improvement in the manufacture of cast-iron railroad wheels nor any mechanical means by which such manufacture could be practised.

(Here, by agreement between the parties, the continuation of the cross-examination of this witness is adjourned to Wednesday morning, the 10th inst., at half past nine o'clock, the time for taking testimony being extended accordingly, but only for the purpose of concluding the examination of this witness, and not for any other or further exam-
220 ination; and now, October 10th, at 9½ o'clock, a. m., met pursuant to adjournment, and cross-examination of witness continued.)

Q. 33. I understand that, in your opinion, it is essential in the com-

plainant's process that all parts of each wheel should be heated to the same degree, and that the heat from the fire should be introduced into the annealing furnace until this uniformity of temperature is established, and shall then cease. Am I correct in this understanding?

A. You are correct in understanding that, in my opinion, in practising the complainant's process all parts of the wheel deposited in complainant's furnace, should be heated substantially to the same point. You are not correct in understanding that it is my opinion that the fire should then cease, my understanding being that the wheels should, after being heated, be permitted to cool gradually, but I do not consider it essential that the introduction of heat into the furnace should be stopped during such gradual cooling because it is evident that if the walls of the furnace are comparatively thin, the introduction of heat into the furnace during the cooling might be a matter of necessity in order to make it sufficiently gradual for every part of each wheel to cool and shrink simultaneously.

Q. 34. Will you now please state whether any means are provided in the complainant's patent for ascertaining when all parts of the wheels are heated to the same temperature, and if you state that any such means are provided, please refer to the language in the letters-patent wherein such directions are contained?

A. The patent states, in one part, that "The temperature of the furnace or chamber and its contents" is "gradually raised to a point a little below that at which fusion commences;" and in another part, when speaking of the effect of this operation, it states, "By this process, all parts of each wheel are raised to the same temperature." These sentences of the patent instruct a person practising the invention,
221 that if the temperature be gradually raised to the point indicated, the required effect will be produced. The operator, therefore, who is accustomed to melting iron, can easily ascertain whether the wheels have arrived at the requisite point, by examining his furnace and noting the color of the wheels due to the heat, and after a few examinations of this kind in connection with observation of the time required to produce the effect with the quantity and kind of fuel used by him, and the distance to which the damper of the furnace is open, will be able to perform the process by regulating the burning of his fuel by the damper, without examining his furnace. The furnace represented in the drawings of the patent may be examined during the raising of the temperature, by slightly lifting one side of the cover for a moment.

Q. 35. What kind of a cover is represented in the complainant's drawings?

A. It is marked in the drawing, sheet-iron cover; but the thickness is such that I should suppose it to be made of what is commonly called boiler plate, which is very thick sheet iron. It is also represented as slightly dome shaped, the object of which is, I suppose, that it shall retain its shape even when heated very hot.

Q. 36. Please state of what material a speculum, such as described in article entitled "Speculum," taken from the London Encyclopædia, vol. xx., p. 757, is composed?

A. I suppose it to be formed of the usual speculum metal, which is an alloy of copper and tin in the proportions of about two parts of copper to one of tin. The alloy is highly crystalline and exceedingly brittle throughout, in whatever manner it may be cast.

With the consent of defendant's counsel, the following questions are asked as a redirect examination of the witness:

1. Considering the improvement set forth in the complainant's process, simply as a process of annealing, and irrespective of the peculiar character or mode of forming the article operated upon, is there
222 any, and if yea, what difference between it and the processes of annealing described in the extracts from public works to which you have been referred in your examination-in-chief?

A. There is a substantial difference between it, so considered, and the processes referred to in the question. All those processes, considered simply as annealing processes, may be divided into two classes; which are, first, those in which the article, while hot, is permitted to cool very gradually, instead of cooling comparatively rapidly, as it naturally would, if exposed to the air during such cooling; secondly, those in which the article is first permitted to become cold in the natural way, and is subsequently heated to a low red heat, and then permitted to cool very gradually. Of the first class, the annealing of glass and of the speculum, described in the Philosophical Transactions, as made by Lord Oxmantown; of the second class, the annealing of iron and steel wire, as described in the Franklin Journal, vol. iv., pp. 45 and 46, is an example. The process described in the complainant's patent, considered as supposed in the question, differs substantially from the first class, in the respect that the article, although taken hot from the mould, is heated to a higher temperature than it is when so taken, before being permitted to cool gradually. It differs substantially from the second class, in the respect that the article is not permitted to become cold before it is reheated. Both of these differences are irrespective of the degree of heat required for performing the complainant's process, which is much higher than that required for performing the processes described in the extract. The result of the process is also substantially different from those described in the extract, being to preserve the distinctive characteristics of the hard and soft portions of the article operated upon; while the result of all the other processes is to reduce the material of the article to a uniform condition throughout.

Q. 2. Please read in the deposition of George G. Lobdell, taken in this case, an agreed true copy of which is now shown you, the answer of said Lobdell to question three, and state whether or not, in
223 your opinion, the process of annealing therein described by him embodies the improvement described in the complainant's patent, and give your reasons for the conclusion you may express.

A. In my opinion, the process described in the answer referred to in the question, is substantially different from that described in the complainant's patent; the operation of the process described in said answer is that all parts of the pulley should be caused to cool alike, in contradistinction to cooling with different speeds by one part remaining hot longer than the other. The description in the said answer is very indefinite, so that it is not certain, from the description, whether the article to be operated upon was taken hot from the mould or not, but I think the presumption is that the witness intended to be understood that it was taken hot from the mould. If this be the case, the idea of heating up or raising the temperature of the oven is nowhere suggested or described; nor are any means described by which the heat could be regulated, as the only description is that the contents of the cupola were hauled out (of the cupola) covering the pot, and it was a matter of mere chance whether these contents were large or small as compared with the size of the article. No means also are described or suggested of regulating the cooling so that all parts of the article should cool and shrink simultaneously, it being a mere matter of chance whether

the mass of material hauled from the cupola should cool down in a longer or shorter period of time. The object and effect of the process described in the said answer are also substantially different from the object and effect of the complainant's process, in the respect that one of the objects of the former was to make the articles soft, so that they could be turned easily, and as pulleys are always turned upon the rim, the object and effect was to make the rim soft, whereas the object and effect of the complainant's process is to leave the rim hard. The said answer does not describe or suggest any improvement in the manufacture of cast-iron railroad wheels, or any means by which such manufacture could be practised; in fact, by stating that one of the results
224 of the process was to render the articles soft, it suggests that the process would be hurtful if applied to the manufacture of cast-iron railroad wheels in which the portion corresponding to the part of a pulley which is to be soft (the rim) must be left hard. The process also does not suggest or describe the manufacture of any article by casting it in a mould composed in part of iron and in part of sand.

Q. 3. Please read in the deposition of Paul A. Sabbaton, taken in this case, an agreed true copy of which is now shown you, his answers to questions six and seven, and give your opinion, with the reasons therefor, as to whether or not the mode of treatment therein described embodies the improvement set forth in the complainant's patent.

A. The process described in said answers, as I understand them, is substantially the same as that described in the answer of Geo. G. Lobdell, referred to in my last answer, although there is a variation in the mode it is practised. But the information conveyed is specific, as to the fact that the castings were taken out of the moulds as hot as they could be removed safely. The two answers referred to, also do not state that the article was softened. In my opinion the process described in the said two answers, is substantially different from the process described in the complainant's patent, for the same reasons that I have given in my preceding answer, with the omission of what I have therein said as to the suggestion that the process would be hurtful if applied to the manufacture of cast-iron railroad wheels, by reason of the softening of the article.

Cross-examination resumed by Mr. Collier:

Q. 37. If railroad wheels cast in a chill were subjected to a process such as described in those extracts denominated by you class No. 1, in your first answer in reëxamination, would not the result of the process be to preserve the distinctive characteristics of the hard and soft portions of the wheels?

A. I think that one of the results would be to preserve the distinctive characteristics of the hard and soft portions of the wheels.

225 Q. 38. When you state that the result of the processes described in the two classes into which you have divided those extracts, is to reduce the material of the article to a uniform condition throughout, is not your opinion as expressed based upon the fact that such articles are in a uniform condition when placed in the annealing furnace?

A. My opinion is not based upon the fact that such articles are in an uniform condition when placed in the annealing furnace, because the articles referred to are harder in some portions than others. The condition of the material is substantially of the same character throughout, but varies in the degree of hardness, the variation in some of the articles being great.

Q. 39. If railroad wheels cast in the "ordinary manner," as referred to in Whitneys patent, were subjected to a process such as described in the answers to questions 6 and 7, described in the deposition of Paul A. Sabbaton, please state what would be the effect upon the wheels as to preserving the distinctive characteristics of the hard and soft portions of them?

A. I cannot state positively what would be the effect upon the wheels as to preserving the distinctive characters of the hard and soft portions of them, but my impression is that it would be preserved.

Q. 40. State wherein, if at all, the result or effect upon railroad wheels of the process, as described by Sabbaton, would differ from the result or effect produced by Whitney's process?

A. It would differ in this respect, that the strains produced by cooling down to the temperature at which the wheels were when taken from the mould would never be retrieved, there being no reheating to produce that effect, even if the distinctive characters of the several parts of the wheel were unaltered; and the presumption is that a railroad wheel treated as described by Sabbaton would be of such uncertain strength when cold that it could not be depended upon.

Q. 41. Your opinion as to the effect, as expressed in your last
226 answer, is based upon your opinion that in such process there would be no reheating of the wheels when placed in the coals, is it not?

A. It is based upon the belief that in such process there would be practically no raising of the temperature of the wheels, and that the cooling would not be regulated, or be slow enough to permit every part of the wheel to cool, and shrink simultaneously. Even if there were a raising of the temperature of the wheel, (which I do not believe,) the raising could not be such as to produce the effect required by the Whitney process, because the means described are insufficient for such purpose; but even if the required effect were produced, the regulation of the heat in cooling required by the Whitney process would not be obtained by the Sabbaton process, as there are no means provided for such purpose, and the matter is left to chance.

E. S. RENWICK.

Complainant's counsel offers and by consent puts in evidence a copy of an extract from the Franklin Journal, vol. iv, pp. 46 and 47, and it is agreed that the same is a true copy, and may be used the same and with the same effect as if said volume were itself put in evidence; and said copy is marked by the commissioner Exhibit T.

EXHIBIT T.

The Franklin Journal and American Mechanics' Magazine, Phila., vol. iv, 1827, pages 46 and 47.

On the proper method of casting the rims or felloes and the naves of wheels in cast iron, and affixing wrought-iron spokes in them. By Jacob Perkins, esq.

In the ordinary method of doing this the wrought-iron spokes are laid in their places, in the sand moulds, and the melted cast iron
227 is poured in at the same time, both to form the rim and the nave. The consequence of this evil practice is that the rim, in cooling, shrinks, and, as the spokes are fixed immovably in the nave, they cannot move inwards as they ought to do, and the rim, of course, breaks.

Now, in order to avoid this misfortune, we have only to cast the rim first, and allow it to become quite cold, whilst the spokes are at liberty to move in the mould, during the time the rim is cooling; the nave may then be cast, and the wheels will remain perfectly sound.—[Tech. Rep.

228 DEFENDANT'S TESTIMONY.

Deposition of Paul A. Sabbaton.

PAUL A. SABBATON, a witness produced on the part of the defendant, having first been duly cautioned and sworn, in answer to interrogatories propounded to him by counsel for defendant, did depose and say:

Ques. 1. State your name, age, residence, and occupation.

Ans. Paul A. Sabbaton; aged (77) seventy-seven years; residence in Albany, New York; engineer; I was an iron founder originally.

Ques. 2. State how long ago you first had any knowledge of the business of iron-founding, and how long that knowledge or experience continued.

Ans. It began in 1810 and followed it to 1840. It was in New York.

Ques. 3. How extensively was you engaged in the iron-founding business?

Ans. I was coequal with any of the foundries in New York in making engines and castings of all kinds for the Government. I made nearly all the shot that was used by the Government in the war of 1812. At that time I was only foreman and manager.

Ques. 4. State whether or not, during the time you was so engaged in the iron foundry business, you made any castings that it was found necessary to use any process of annealing or prolonging the time for cooling the same; and if yea, what castings—what process was used?

229 Ans. There were certain castings I found it necessary to anneal. The castings were gun-carriage wheels and large machinery wheels. They were annealed to prevent the unequal shrinkage. This was not annealing proper; but a process to prevent unequal shrinkage by the parts of the wheel not all cooling together. Annealing changes somewhat the character of the metal. The process was by exposing certain portions and shielding other portions of the castings from the action of the air, and sometimes pouring water in the center of the hub-wheel. The air would not be sufficient. The object of all which was to obtain an equal cooling of all parts of the wheel.

Ques. 5. State whether, during this process, or in any process used by you for the purpose of prolonging the time of cooling, heat was applied to the castings after they were taken from the moulds.

(Objected to. Question waived.)

Ques. 6. State whether any other mode or process of prolonging the time of cooling was used by you than that described in your last answer.

Ans. When the castings would admit of it they were placed in the dump of the cupola, which partially annealed them, and by suffering them to cool gradually would have the effect of preventing them cracking. The dump of the cupola was hot coals out of the cupola, and the heat applied to the wheels was very great.

Q. 7. State what condition the wheels were in with reference to heat when they were put in the dump of the cupola, and describe the form of this dump.

Ans. The castings were taken out of the moulds as hot as convenient, as they could be removed safely, and placed in a situation so that the hot

coal from the cupola would cover them up. This dump was merely a hole in the ground in front of the cupola. The wheels were generally left there over night, until morning.

Ques. 8. State whether these or similar processes for prolonging
230 the time of cooling of iron castings, for the purpose of equalizing the contraction, was generally known and used by iron founders.

(Objected to.)

Ans. It was well known.

Ques. 9. State whether you knew at that time, say previous to 1840, of any other modes or processes of prolonging the time of cooling the castings than those above described by you.

Ans. I know of no other mode; but heard from information—No, no; I have seen air and water introduced in the centre to produce the same effect—cold air.

Ques. 10. State whether you have known of any other mode of extraneous heat being applied to the castings than that described by you above?

(Objected to.)

Ans. I don't remember.

Ques. 11. State how large these castings were which were put into this hole in the ground and the coals of the cupola put over them, and what kind of castings they were.

Ans. They were from probably 4 feet downwards in diameter. This process was not used for only two or three wheels, as a trial, and not as a regular business. The castings were machinery cogwheels. These processes were known and used as early as 1810. At that time coke was the fuel used in cupolas in melting iron, which had a tendency to harden the iron, and therefore the castings were than more easily fractured by unequal contraction, and annealing became more necessary. Since anthracite coal began to be used the castings are softer and not so liable to be affected by unequal contraction.

Cross-examination by counsel for the complainant:

Ques. 1. In what kind of moulds were the castings you have mentioned, as being subjected to the processes you have described, made?

Ans. Moulds; no chills.

231 Ques. 2. Was the use of chills in iron founding then known and understood?

Ans. Not generally; and not practised much.

Ques. 3. Was it not a distinct branch of the art of iron founding?

Ans. We knew nothing at that time of chills; we knew it was used in England.

Ques. 4. Is not the treatment of chilled castings attended with difficulties not encountered with ordinary castings of iron?

Ans. Yes.

(Signed) PAUL A. SABBATON.

Deposition of George H. Thacher.

GEORGE H. THACHER, a witness for defendant, being first cautioned and duly sworn, deposes and says:

Ques. 1. State your name, age, residence, and occupation.

Ans. George H. Thacher; 48 years; Albany, New York; manufacturer of car wheels; and at present mayor of the city of Albany, N. Y.

Ques 2. State whether suit was at one time commenced against you by Mr. Asa Whitney, complainant in this suit, for an alledged infringe-

ment of his patent for an improvement in annealing and cooling cast-iron car wheels. State what was the result of such suit. Please state fully all the particulars.

Ans. There was a suit commenced against me by Mr. Whitney, the complainant in this suit. The matter was finally settled, on Mr. Whitney's application to me. Mr. Whitney came here, as I suppose and believe, on purpose to see me. My impression is that it was in the autumn of 1856. That was after a large amount of testimony had been taken in the case, mainly, and I think almost entirely, on the part of defendant. I think, on every occasion of taking testimony, Mr.
232 Whitney was represented by his son or counsel, and generally by both. I gave notice, as the law required, of the books to which I would refer in the pending trial, of the various annealing processes applied to cast-iron previous to the time of his alleged invention, together with extracts from said books, with their title, page, and date of publication. The testimony taken and the notices referred to were all known to Mr. Whitney at the time of his application to me for settlement. Mr. Whitney himself professed that it would be better for both of us to adjust the matter amicably. I told him I thought so too; that I did not desire litigation. He proposed that I should pay the legal costs that had been incurred, and he would give me a release of all claims on account of an infringement of his patent. I asked him how much the cost would be. He said he did not know definitely; but he said he thought it would be about one thousand dollars. I told him that I could give him no answer until I consulted my lawyer, Mr. Blatchford; that I had no doubt whatever of successfully contesting his claim; that a settlement of the matter would with me be entirely a question of dollars and cents; that if my lawyer should advise me that it would be cheaper for me to pay the amount, or rather the costs, as he proposed, than it would be to pay the expenses of the trial, then I would accept of his proposition. The idea I expressed to Mr. Whitney was, that if it cost me more to beat him on the trial than it would to pay the costs, as he proposed, I would accept of his proposition—that would depend upon my lawyer's advice. He advised me that the expenses would be greater in case it came off. I authorized Mr. Blatchford to notify Mr. Keller, Mr. Whitney's counsel, that I would meet Mr. Whitney, and settle on those terms. We accordingly met in Mr. Keller's office, and effected a settlement accordingly.

Ques. 3. When did this communication between you and Mr. Whitney take place; and, did you go to see him, or did he come to see you?

233 Ans. He came to see me; and the conversation took place at my foundry, or at the Delavau House, I cannot recollect which. It may have occured while walking down from my office, at the foundry, to the Delavau House. I remember very well of walking from my office down to the Delavau House with him.

Ques. 4. Did you apply to Mr. Whitney, or any one else, for a settlement of that suit?

Ans. Never, to my knowledge.

Ques. 5. Did you ever pay him for any infringment of his letters-patent?

Ans I never intended to, and I do not know that I ever did.

Ques. 6. Did you in that settlement, acknowledge that you had infringed his letters-patent, and agree thereafter to desist from further violation of his letters-patent?

Ans. I have no knowledge of any such acknowledgment or agreement. I remember saying, however, that I should discontinue the use

of my process, because I considered it, after investigation, as of no advantage, compared with the common process of covering the wheels with sand, and that I considered his process, if followed according to his patent, as a positive injury to the wheel. As to the papers executed at the time of settlement, I signed them, if I signed at all, without reading, as they were presented to me, inasmuch as I considered it an end of the whole matter.

Ques. 7. For what amount of damages did Mr. Whitney sue you; and did you pay him anything except the costs of the suit that had there occurred?

(Objected to by counsel for complainant.)

Ans. Mr. Whitney claimed from me, according to my recollection, damages to the amount of sixty thousand dollars. I never paid him anything except the costs of the suit, to my recollection.

234 Ques. 8. Were you able at that time to have paid sixty thousand dollars damages, if judgment had been rendered against you for that amount?

(Objected to by counsel for complainant.)

Ans. Yes; more than twice that amount.

Ques. 9. State whether you understand the process of a new and improved mode of annealing car wheels, described in the letters-patent of the defendant, a copy, dated May, 1861, of which said letters is now shown you; and if you shall answer yes, whether that mode is similar to the mode used by you for annealing car wheels, at the time suit was commenced against you by the complainant?

Ans. I know nothing of the mode except as described in the paper now before me, which I think I understand, and I consider it essentially different from that used by me at that time.

Ques. 10. Please describe the process used by you for annealing cast-iron car wheels, prior to the settlement above referred to.

Ans. I used a circular pit, large enough to easily receive the wheels, in which I placed from six to eight wheels; there was no provision for passing a current of air through the pit, or around or between the wheels; I placed the first wheel upon the solid bottom of the pit, then threw around the rim of the wheel in the space between that and the lining of the pit, a quantity of charcoal sufficient to fill the space to the upper edge of the wheel; I placed another wheel upon the first, filling in with charcoal the same as before, and so on until the pit was filled with wheels, the hub of each wheel being in close contact with the hub of the one below it, and all so placed that the cores of the wheels formed a continuous tube from the bottom to the top; over the upper wheel I placed a thick layer of sand, after which I left the wheels in the pit for about three days; these wheels when placed in the pit, were taken from the flasks as soon as they were cooled sufficiently to bear moving

235 with safety. In my process, the charcoal was thus applied only to the rims of the wheels, being placed only between the rims of the wheels and the wall of the pit, and not being interlaid between the plates of the wheels. Our original motive for doing this, was not so much for the purpose of annealing as for carbonizing the rim or chill of the wheel; but we found, after experience, that the carbonizing was scarcely perceptible, and that the annealing in that mode was no better than the ordinary mode of covering the wheels with sand. There was no opening of any kind in the bottom of the pit, and the only air admitted was that which passed down through the eyes or hubs of the wheels, and the quantity of air so admitted was so limited, that the

charcoal was usually—at the end of the three days, when the wheels were taken from the pit—not more than one-third consumed.

Cross-examination by Henry Baldwin, jr., counsel for complainant.

Ques. 1. What amount did you pay Mr. Whitney on settlement of the suit against you?

Ans. I must speak from recollection; I think it was from thirteen to fifteen hundred dollars; I know I thought at the time it was like paying black mail.

Ques. 2. Did you take a receipt for it?

Ans. I took a release of all claims against me in full settlement of the suit.

Ques. 3. Can you produce that release? and if yea, please do so.

Ans. I cannot say, but I will try; it must be among my old papers somewhere.

Ques. 4. When did you first engage in the manufacture of car wheels, and where?

Ans. In the fall of 1852, and here, in Albany.

Ques. 5. Did you start a new manufactory, or did you buy out or buy into an established business?

Ans. I started a new manufactory.

Ques. 6. Did you commence in 1852 to anneal car wheels by the process you have described as yours?

236 Ans. Shortly after commencing the business I used this process, I think; for the first few casts I used the sand process.

Ques. 7. How long did you continue to use the charcoal process you have described?

Ans. I used it up to the time of selling out my business, I think, in the spring of 1855.

Ques. 8. To whom did you sell out your business?

Ans. To Mallory, Morrison & Co.

Ques. 9. When did you reëngage in the business of manufacturing car wheels—where, and with whom?

Ans. These parties failed, and I purchased the business from their creditors, in the winter or spring of 1858.

Ques. 10. What process did they use while they had the business?

Ans. I never observed it practically, except that I know that they covered their wheels with sand, and passed a current of air through the hubs while in the pits. I never heard of their using any fuel.

Ques. 11. What process have you used since you resumed the business, up to the present time?

Ans. I placed the wheels in the pit, in the same position relatively to each other, as before described, and simply covered with sand, using no fuel of any kind; that is the process I am using to-day.

Ques. 12. Were you engaged in iron founding, in any of its branches, before you began the manufacture of car wheels?

Ans. From 1849, I was engaged in the business of manufacturing stoves, up to the time I commenced manufacturing car wheels, in 1852.

Ques. 13. Were you familiar with the practical part of that business?

Ans. Yes; I attended to the founding part.

237 Ques. 14. Were you one of the firm of Learnard & Thacher, or B. P. Learnard & Co., sometime, of Albany, New York?

(Objected to by defendant's counsel, as immaterial and irrelevant.)

Ans. At the first, the title of the firm was B. P. Learnard & Co., afterwards the title was changed to Learnard & Thatcher, I being a member of both firms.

Ques. 15. Have you at any time seen practised, a process of annealing pulleys or machinery wheels, by placing them red hot within a rim of sheet-iron, covering them and filling the rim with charcoal, and covering that with sand, leaving breathing-holes for the admission of air?

(Objected to by defendant's counsel, as calling out entirely new matter, and in no way touching any matter referred to in the examination-in-chief.)

Ans. Not to my recollection.

Ques. 16. When did Mr. Whitney take his first step in his suit against you?

Ans. I cannot fix the time, but I think it was about the time I sold out, as stated before.

Ques. 17. Did Mr. Whitney seek to enjoin you, or did he sue you for damages alone?

Ans. He sued me for damages. If he sought to enjoin me, I don't know it.

Ques. 18. Did you understand the amount you paid Mr. Whitney to be the amount of recoverable costs, or the amount of expense he had incurred up to the time of settlement?

Ans. I know nothing about it except it was the costs, as represented to me.

Ques. 19. Before you saw Mr. Whitney in Albany, had you not called to see him in Philadelphia, in relation to this suit?

Ans. I never called to see him; I called at his foundry, to see his process as actually in use, so that I could better understand how to shape my defense.

238 Ques. 20. Supposing, Mr. Thacher, that Mr. Whitney has stated, as his best recollection of the negotiations which led to the settlement of the suit between you, that, being in Albany, he met you on the street; that you remarked to him that your mutual friends thought that you and he ought not to be fighting; that he replied that he did not want to fight—that he had no desire to make money out of you, but only wished to stop the infringement of his patent; and that from this point the subsequent settlement followed. What conflict is there between such a statement and your recollection of the matter?

Ans As to his happening in Albany, I know nothing about it—whether he came on purpose to see me, or was simply passing through. When I met him first I do not recollect; we had, I remember, quite a long conversation; it was not unfriendly, but quite decided on my part. I knew nothing about mutual friends; I did not know then, nor do I now, that we had any mutual friends who took any interest in the matter. In the course of the conversation I know that we mutually expressed an aversion to litigation, and at that time Mr. Whitney proposed the mode of settlement as above stated, and I answered as before stated. Mr. Whitney did say, substantially, that he did not wish to make any money out of me, but he wished to maintain his rights under his patent. That is as near as I can recollect.

Ques. 21. Who was present, beside yourself and Mr. Whitney, at this interview?

Ans. I cannot remember that any one was present.

Ques. 22. You have said that from '52 to '55 you used a process of annealing or carbonizing car wheels, and have described that process in detail; and you have further said that you have since used, and are now using, the sand process. Which of the two processes have you found best adapted to the manufacture of car wheels?

Ans. I have found the sand process to be the best and cheapest.

239 By consent, counsel for defendant puts the following:

Ques. 1. Do you understand the process of annealing described in Mr. Whitney's patent; and if yea, in your opinion, could that description be followed in the annealing of chilled cast-iron car wheels without destroying the chill or injuring the texture or fibre of the wheel?

Ans. I understand it. If the process, as described and claimed by him, was strictly followed, I believe it would utterly ruin the chill of the wheel, and materially diminish its strength. I do not believe that Mr. Whitney has ever conformed to his own process, as claimed.

(Last clause of above answer objected to by complainant's counsel.)

Recross-examination by complainant's counsel:

Ques. 1. At what stage of Whitney's process, as claimed by him, the same being strictly followed, would the chill of the wheel be utterly ruined, and its strength materially diminished?

Ans. When, after its being removed from the mould, and placed in his heated oven, its temperature is raised to a point a little below the point of fusion. It cannot be moved from the mould till it has cooled hundreds of degrees below the point of fusion, and the reraising of the temperature to near the point of fusion would redisturb the particles of the iron and the texture of the chill.

Ques. 2. Then, as you understand Mr. Whitney's claim, to follow his process you consider that it would be necessary to raise the temperature of all parts of the wheels to a point a little below the point of fusion.

Ans. He makes no distinction between the parts of the wheel; he claims to raise the temperature of all parts of the wheel to the same point; that is, to a point a little below that at which fusion takes place.

Ques. 3. Do you understand that, to follow Whitney's process as claimed, it is necessary to raise any part of the wheel to a point a little below fusion?

240 Ans. If his process be strictly followed as claimed, I should say yes.

Ques. 4. When would you fix the temperature of a point a little below fusion?

Ans. When the temperature is so high that the iron begins to show indications of softening.

Ques. 5. Which part of a cast-iron car wheel would first begin to show this softening; that part formed in a chill, or that part formed in the sand part of the mould?

Ans. That would depend somewhat on the different proportions; whichever part of a wheel was the thinnest, that part would show it first.

Ques. 6. Then, according to your understanding of Mr. Whitney's claim, in your opinion, his process would not be followed strictly, unless the heat was raised to a point at which the iron began to soften?

Ans. Raised to near that point. We would allow a little for what is meant by a little below fusion.

Ques. 7. Then I understand you to say that, although the iron may not begin to soften at that point, yet that point would still be so high as to ruin the chill and materially diminish the strength of the wheel?

Ans. If the temperature were raised to very near that point, I should think that would be the effect.

Ques. 8. And you understand that, to follow Mr. Whitney's claim strictly, the temperature must be raised to very near that point?

Ans. If he raised the temperature, as he claims, to a little below the point of fusion, it must be very near that point.

Ques. 9. Do you understand Mr. Whitney's claim to involve, as a necessary stage in his process, the raising of the temperature to a point a little below fusion?

Ans. If he carries out the entire process as described in the
241 claim, I do so understand it. I think he uses, and must use, in order to make a good wheel, only a part of his process; that, in proportion as he raises the temperature above what existed in the wheel at the time of placing it in the pit or oven, in that proportion he injures the texture of the wheel. I believe that the sooner the wheel can be cooled consistently with an equalization of its tension, the better it will be in every respect.

Ques. 10. If Mr. Whitney's furnace or chamber be so constructed, of such material, and subject to such control, that the temperature of all parts of the wheels deposited therein may be raised to the same point, would not that produce an equalization of their tension?

Ans. If such a thing were possible, I would say yes; but I do not consider that the thick parts and the thin parts of the wheels, it retaining its full shape, can be raised, in point of temperature, to an absolute equality.

Ques. 11. Would not such a thing be possible if the furnace or chamber were made of such form, and had such appendages connected with it, as to enable the operator to control the quantity and intensity of the heat used by admitting more or less of it into the chamber, or excluding it entirely?

Ans. I do not believe any furnace can be constructed so that any operator, without the attributes of omniscience and omnipotence, could so gauge and control the heat as to produce an absolute equality of temperature as between the thinner and thicker parts of the wheel. We can only approximate the end designed to be attained by Mr. Whitney.

Ques. 12. Would such approximation be beneficial?

Ans. It would depend upon how the process was conducted; one process might attain that end and injure the wheel, and another without injuring it.

(Signed) GEO. H. THACHER.

242 *Deposition of George S. Bosworth.*

GEORGE S. BOSWORTH, a witness for defendant, being first cautioned and duly sworn, deposes and says:

Ques. 1. State your name, age, residence, and occupation.

Ans. Geo. S. Bosworth; 56 years old; reside at Troy, N. Y.; my occupation is that of a moulder; I have been foreman of a car-wheel shop for the last fourteen years—the shop of Mallory & Ingalls. Before this firm, the establishment was that of H. Stanley & Co. I have worked at iron castings for the last forty-one years.

Ques. 2. State what process of annealing iron castings, if any, you have known to be used prior to 1847.

Ans. I have known no other process than that of putting charcoal around certain portions of castings that would cool the quickest, so that it all would shrink alike. That was to keep it from cracking.

Ques. 3. What kind of castings have you known to be so treated?

Ans. Mill gearing, spur wheels, also fly wheels, and the arms of fly wheels they used to keep hot, and bare the rims; this was done right in the mould.

Ques. 4. State whether you have read and understand the process of annealing and cooling cast-iron car wheels, as described in the letters-patent issued to Asa Whitney, April 25th, 1848, a copy of the same being now shown you.

Ans. No, sir; I have never read it. I have now read the copy shown me, and understand the process.

Ques. 5. What experience have you had in casting and superintending the castings and annealing of cast-iron car wheels?

Ans. I have seen to the mixing of the iron, and melting and moulding of car wheels for the last fourteen years; I have had the whole
243 and sole control of the works of Mallory & Ingalls for the last six years, where they cast from twenty to forty-four wheels per day. I invented a single-plate wheel, which is now in use, and has been since 1859; has been used on the Hudson River Railroad ever since 1859.

Ques. 6. From your experience of forty-one years in iron founding, and your experience of fourteen years in superintending the car-wheel manufactory of Mallory & Ingalls, as stated above, what, in your opinion, would be the effect upon a chilled cast-iron car wheel, if it were taken from the moulds as soon after being cast as it could be moved with safety, or before it had become so much cooled as to produce any considerable inherent strain between the thin and thick parts, and putting it in this state into a furnace or chamber that has been previously heated to a temperature as high as that of the wheels when taken from the moulds, and as soon as it is so deposited the temperature of the furnace or chamber, and the wheel gradually raised to a point a little below that at which fusion commences?

(Objected to by counsel for complainant.)

Ans. I think, sir, it would have a tendency to draw the chill.

Ques. 7. What would be the effect of such a process, and what do you mean by drawing the chill?

(Objected to by counsel for complainant.)

Ans. The effect would be to soften the chill; that is what I think it would do. I mean by drawing the chill, taking the hardness out of the iron which has been formed by the chilling process. I think the temper can be taken out of a chill just as much as out of steel.

Ques. 8. State whether you have ever made any experiments to test this matter; and if you shall answer yea, then state what those experiments were.

Ans. My experiment was all an accidental experiment. It was a piece of car wheel going through the cupola without melting, ex-
244 cept a little of one end; it was dropped to the bottom of the cupola, and laid there in the hot coals all night. That drew the temper out of the wheel. By the temper, I mean the chill of the wheel, so that the chill part of the wheel, that which had formerly been chilled, was filed—could take a file and cut right into it. You can't file into the chill part of a wheel, no more than you can into steel; you may mark it, and that is all you can do.

Ques. 9. State whether the part of the wheel above spoken of, not melted, and from which you say the chill had been drawn, had been raised, in your opinion, to a greater temperature of heat in the bottom of the cupola, than a point a little below that at which fusion commences.

Ans. I don't think it was a greater heat; if it had been, it would have melted.

The witness being cross-examined by counsel for complainant, testified as follows:

Ques. 1. Where did the piece of car wheel that went through the copola come from?

Ans. It was a piece of an old worn-out car wheel that had been broken up.

Ques. 2. Was it put into the cupola, with other pieces of wheels, to melt down?

Ans. It was put in with other pieces of wheels and pig iron, to be melted down, making a part of the last charge to be run into new wheels.

Ques. 3. Was the rest of the charge melted down?

Ans. That was the only piece I saw unmelted, the rest was all melted down.

Ques. 4. How do you account for that piece not having been melted?

Ans. I cannot tell why it did not melt, nor can I say how high it had been heated, but from its appearance I should say it had been heated to a red heat. It was red after it became cold; one corner of it had been melted off.

245 Ques. 5. Did you ever work at N. Starbuck's foundry, in Troy, from 1840 to 1845, or prior to that time?

Ans. I think I worked for him before 1840.

Ques. 6. Did they use at Starbuck's, prior to 1845, any mode of annealing castings with charcoal, otherwise than as you have already described?

Ans. No, sir; they never had any annealing process for car wheels, or anything else, to my knowledge. I worked for Starbuck, off and on, for from 15 to 18 years, all prior to the year 1850; during that time he never pitted a wheel, and never used any annealing process; the wheel he made did not require any pitting or annealing; they were a spoke wheel, with a split hub, to allow for the shrinking.

Ques. 7. Did he ever, to your knowledge, take a car wheel or other castings red hot from the moulds, place it within a rim of sheet iron placed in the bottom of the moulding floor, and cover the wheel with charcoal and cover the charcoal with sand, providing breathing holes to support combustion of the charcoal?

Ans. He never did that thing.

Ques. 8. Would you have known it if such process was used during the time you worked there?

Ans. Certainly I should have known it; I made all the wheels that were made there while I was there; we threw them right out on the floor; the form of the wheel was such as to compensate for shrinkage, without the process of annealing.

Ques. 9. Is not the manufacture of cast-iron car wheels a distinct branch of the art of iron founding, from the manufacture of ordinary castings?

Ans. It is distinct in this way—there is not one man in a thousand that can make a good car wheel.

Ques. 10. Do you know who first occupied the foundry that Anson Atwood has more recently occupied?

Ans. Atwood & Co., I think, first occupied it; I think they built the foundry.

246 Ques. 11. Have you ever seen practised the process described in Mr. Whitney's patent, which you just now read.

Ans. I never have seen it practised.

Ques. 12. When were car wheels first made, to your knowledge, of chilled cast iron, with a solid hub?

Ans. The first solid hub wheel that I knew anything about was Eddy's, of Waterford. He made the double-plate or convex and concave wheel.

G. S. BOSWORTH.

247 *Deposition of George G. Lobdell.*

GEORGE G. LOBDELL, having first been duly affirmed, in answer to interrogatories propounded to him by defendant's counsel, did depose and say:

(Said witness being examined by consent, and all objections to the character of the officer before whom he is examined, and notice being waived.)

Ques. 1. State your name, age, residence, and occupation?

Ans. George G. Lobdell; forty-eight (48) years; New Castle Hundred, New Castle County, Delaware; am a founder and machinist.

Ques. 2. State how long you have been engaged in the business abovenamed, whether you have ever been engaged in the business of making cast-iron car wheels; and if yea, how long?

Ans. I have been engaged in the foundry business since May, 1833; since about October, 1833, as near as I can recollect, I have been engaged in the business of making cast-iron car wheels.

Ques. 3. State what process, if any, you have known to be used for the purpose of annealing or prolonging the time of cooling of iron castings, prior to the year 1847?

Ans. I have known small pulleys to be placed in iron vessels or any old pot, with charcoal and iron trimmings packed around them, and this pot placed under the cupola, the contents of the cupola hauled out, covering the pot, both for the purpose of making them soft, so that they could be turned easily, and for the purpose of preventing the
248 arms from fracture. The cause of the fracture of the arm of a pulley was because one part remained hot longer than the other, consequently the hub being the heaviest part of the pulley and the last to cool, would produce a strain on the arm when it cooled or contracted; this process caused all parts of the pulley to cool alike.

Ques. 4. Was this process usual to your knowledge,or a similar process, for different kinds of castings?

(Objected to.)

Ans. I don't think I ever knew it to be applied to large castings; different parts of large castings were generally made in such proportion as would cause all the parts to cool alike. In arranging mill gearing (cog wheels) the different parts of the wheel were made so as to accomplish this object, that is, that one part should not cool before the other.

Ques. 5. Would or could not, this process that you have spoken of as having been used in the annealing of pulleys, been applied, if desired, to larger castings, and was it or not, a process or principle well known to iron founders prior to 1847?

Ans. It could have been applied to larger castings by having a vessel large enough to contain the casting, and a sufficient amount of heated material to heat the vessels and contents. I cannot speak of what others knew, but I presume iron founders generally knew the cause of the fracture of castings, and could have applied the same means to prevent it that I did.

Ques. 6. To what extent or what number do you manufacture car wheels per year?

Ans. I can hardly tell you how many I manufacture per year, sometimes two hundred a day; seldom less than one hundred a day.

Ques. 7. Do you or not find ready sale for your wheels, and are they in good demand, or otherwise? and state how your wheels will compare in usefulness and durability, if you know, with the wheels manufactured by A. Whitney & Sons, of Philadelphia.

249 (Objected to for its incompetency and irrelevancy.)

Ans. At times I have not been able to fill the demand for my wheels. I have been longer in the business than any manufacturer of chilled railroad car wheels in this country, and consider my wheels superior to those manufactured by Messrs. A. Whitney & Sons, or any other manufacturer.

Ques. 9. Please state whether you have any process for annealing or prolonging the time of cooling your wheels, and if yea, what that process is?

Ans. I have; it is by taking them from the chill as soon as they can be handled, and covering them up with hot sand.

Ques. 9. What do you mean by the chill, and is there any previous preparation of the sand by which they are covered, and are the wheels placed separate or together in cooling?

Ans. By the chill I mean that part of the mould which gives shape to the tread of the wheel, or that part which runs on the rail; there is no preparation of the sand other than have it perfectly dry and heated to a certain degree; the wheels are placed in contact as near as possible in cooling, no additional heat being applied, but that which is in them when deposited and in the hot sand. Sometimes they are placed on their edge, and sometimes on the flat. We have certain pits arranged over which we have machines for hoisting them in and out, and constructed so as to retain the sand around the wheels. When these are full, as is sometimes the case, we place them on the flat, and cover them up with a larger quantity of hot sand, thereby retaining the heat in the wheel or wheels, and prolonging the time of cooling.

Ques. 10. What is the result of this process, as to producing a durable and useful wheel, or otherwise?

Ans. By this process, the different parts of the wheel cool at the same time, consequently there is no strain or tension on any part of the wheel, and the wheels are strong and durable.

Ques. 11. How long have you used this process in manufacturing cast-iron car wheels?

250 Ans. I can't say positively how long. To the best of my recollection, I commenced this process of annealing or prolonging the time of cooling car wheels in the early part of 1848, or the latter part of 1847—December, 1847, or January, 1848.

Ques. 12. What process, if any, did you use prior to that date, in annealing car wheels?

Ans. Not any; the wheels we made then did not require it; they were of a different form from the kind we make now.

(Signed) GEORGE G. LOBDELL.

Cross-examination by Henry Baldwin, jr., counsel for complainant:

Ques. 1. How long prior to 1847 did you know small pulleys to be heated, as stated in your answer to question 3?

Ans. In 1833, and prior to that time.

Ques. 2. Was that mode of treating small pulleys well known in the art of iron founding prior to 1847?

Ans. I learned it of my uncle, who learned the business. How far it

was known to other iron founders, I cannot state. There were a great many secrets connected with the foundry business, which he communicated to me, that others did not know. Whether this was one of them I cannot say.

Ques. 3. Did your uncle practise that mode of treatment of pulleys?

Ans. He did when it was necessary and convenient to do so.

Ques. 4. When was it necessary and convenient to do so, in your practice, or in that of your uncle, as far as you know?

Ans. It was sometimes necessary when pulleys had straight instead of curved arms, and hubs relatively heavier than the rim of the pulley; it was convenient to treat all such pulleys in this way that were not too large in diameter, requiring too large a vessel to hold them, in which case frequently the hole, which was cast in the hub of the pulley, would have water poured in it to cool it.

Ques. 5. What was the diameter of such pulleys? Give the extremes of any pulleys heated that way.

251 Ans. I can't say how large; they were generally small, probably not exceeding fifteen inches in diameter.

Ques. 6. How were those pulleys cast as to the mould; what kind of a mould were they cast in?

Ans. Ordinary sand, moulded in sand; no part of it chilled.

Ques. 7. When did you commence to cast railroad car wheels in chills?

Ans. I can't say positively, but I think as early as October, 1833.

Ques. 8. Did you cast them after that time without chills?

Ans. Not as a general thing after that date. We sometimes now make car wheels without chills, such as manual-labor cars, and hand cars and wheels, the rims of which are too light to admit of being chilled. Of course these unchilled wheels wear out quick compared with the chilled wheels.

Ques. 9. As a term in the art of iron founding, in speaking of cast-iron railroad wheels, which is understood to be meant, chilled or unchilled wheels?

Ans. Chilled.

Ques. 10. Did you ever apply the mode you have described in treating pulleys to a cast-iron wheel?

Ans. No.

Ques. 11. When you adopted the sand process of cooling car wheels, I understand you to say the wheels were different in form from the kind made now. Please explain the difference.

Ans. I am the inventor of what was known as the Bush & Lobdell wheel, the plates of which were convex on the outside. To allow for the unequal contraction occasioned by the chilling of the rim of the wheel, the hubs of these wheels were cut apart transversely, thereby allowing the plates to separate when the rim contracted, and close as the hub contracted by cooling. This was the wheel I made before adopting the process of cooling by covering with hot sand. It was not necessary to use the sand process with this wheel. There was some objection to the hubs being cut apart, or in other words, railroad men prefer-

252 red what was termed a solid, or not divided hub. To make these wheels without dividing the hub, it became necessary to use some process by which the time of cooling would be prolonged, which was done by covering them up in dry hot sand. The difference between the two wheels consisted in the earlier one having the divided hub, and the other having the solid hub. I now make, in addition to these, a single-

plate wheel with arms or brackets on one side of the plate, extending from the hub to the rim. These wheels are cooled in the same way.

(Defendant's counsel being compelled to leave for New York at this stage of the examination, the cross-examination of the witness is continued in his absence.)

Ques. 12. What is the weight of the different forms of chilled car wheels, which you make respectively, taking wheels of the same diameter and each form.

Ans. Single-plate wheels are generally lighter than the double-plate wheels, for the reason that the double-plate wheels made by me, are used almost exclusively for engines and tenders. I make, however, single-plate wheels for these purposes as heavy as the double-plate wheels. The kind of service for which the wheel is required governs the weight.

Ques. 13. From the time when you first commenced this process of annealing car wheels, to wit, from December, 1847, to January, 1848, did you heat the sand before covering the wheels with it?

Ans. Only sufficient to insure its being sufficiently dry.

Ques. 14. Do you consider the car wheels manufactured by Asa Whitney & Sons, of Philadelphia, good, durable, and reliable wheels?

Ans. I consider the wheels manufactured by Messrs. A. Whitney & Sons very good wheels; better than those manufactured by a great many manufacturers in the country.

(Signed) GEORGE G. LOBDELL.

253 *Deposition of Lysander A. Orcutt.*

LYSANDER A. ORCUTT, a witness produced on the part of the defendant, having been by me first duly cautioned and sworn, in answer to interrogations propounded to him by H. L. Burnett, counsel for defendant, did depose and say:

Ques. 1. State your name, age, residence, and occupation.

Ans. Lysander A. Orcutt; age, near 48; reside at Watervleit, New York; my occupation is that of a manufacturer of foundry facings. I own and carry on the establishment.

Ques. 2. Please state how long you have been engaged in the iron foundry business, and the extent of your familiarity and knowledge of that art.

Ans. I commenced in 1835 at moulding and casting, and learned it as a trade; have been in the business ever since. I believe I am practically acquainted with every branch of the foundry business. I am familiar with the wood-work and machine-work as well. I have not only been a practical worker in iron castings and machinery, but have tried to study it very thoroughly as a science. I formerly made it a point to go each year to some of the large iron establishments in the United States, for the purpose of ascertaining what there was new in the business, and their different modes of operating. In this way, I have visited all the principal iron establishments in New York City, Philadelphia, Boston, and Lowell, Massachusetts, and many other places, all for the purpose of perfecting my own knowledge of the science, and keeping pace with its progress.

Ques. 3. Please state whether you understand the process of annealing cast-iron car wheels, as described in the letters-patent issued to Asa Whitney, April 25th, 1848, a copy of which said letters-patent is now shown you.

Ans. Yes, sir; and I have been in Mr. Whitney's establishment, in Philadelphia, and seen the process in use.

254 Ques. 4. Do you understand the process of annealing cast-iron car wheels, as described in the letters-patent issued to A. L. Mowry, May 7th, 1861, a copy of the same being now shown you?

Ans. Yes, sir; I understand it from the copy shown me, but have never seen it in actual use.

Ques. 5. State whether, in your opinion, those two processes are similar or not; and if you shall answer that they are dissimilar, state in what particulars.

Ans. I consider them quite unlike in most respects. Whitney's process, as I understand it, consists in heating up the pits previous to putting the wheels in, after which the heat is continued and increased, the effect of which would be, if increased to the point set forth in his claim, to injure or destroy the chill of the wheel. The other—Mr. Mowry's process—the pit is cold when the wheels are put in, and being packed in common charcoal, the quantity would be insufficient, under any degree of ignition, to raise the wheels beyond the degree of heat they were at when put in; consequently there would be a decrease in the heat of the wheels from the moment they are put in until they are reduced to a black heat, until all the red appearance is gone. These are the two principal or great points of difference in the two processes.

Ques. 6. Would the effects of the two processes upon the wheels be similar, in your opinion?

(Objected to by counsel for complainant.)

Ans. The effects would be quite different so far as the chill is concerned; effecting the equalization of strain, they would not be unlike.

Ques. 7. In your experience and knowledge of the iron founding business, please state what different processes you have known to be used for the purpose of annealing or prolonging the time of cooling of iron castings, by whom used, and what kind of castings.

255 Ans. One very common process is to take castings after cast, and quite hot, at as high a temperature as they can be safely handled, and covering the thin parts in dry sand, while exposing the thick parts to currents of air, and sometimes water; at other times removing the castings as stated, and then laying charcoal around the thin parts and igniting it, while the heavier parts are exposed as before stated. These are the most common modes of annealing castings of unequal thickness; another mode is to put castings in annealing ovens constructed for that purpose. These ovens are made in a great variety of forms, depending upon the kind and shape of castings that are to be annealed or cooled. Pits are sometimes constructed with horizontal and vertical flues, and draughts of air passed through the hollow parts of the castings, while the other parts are left to cool more gradually. I have seen the sand used as far back as 1840, also the water, and I have used the charcoal myself as far back as 1840. These ovens consisted of brickwork of various forms suited to the castings to be cooled; these ovens were above ground, and then the castings were placed in the ovens, charcoal placed around them, then ignited, and left to cool down as the charcoal was consumed. I have used this mode myself as early as 1844. This process was common, I think, among foundry men at that date. The pits with horizontal and vertical flues, with currents of air, I tried in 1852; I don't know of its being used prior to that. The kind of castings I saw treated with charcoal was small pieces of machinery castings and hollow ware. I used it in 1841. While I was with the Starbucks, at Troy, about 1840, the sand and water processes

were used in their establishments and sometimes by putting pieces of castings in the core oven, a heating oven where they dry the core for making the hollow parts of castings. This core oven at Starbucks', which was used about 1840 to 1848, was about six feet long, three feet wide, and three deep; it was built on the surface of the moulding-room floor, in one corner; it was of brick, with iron doors. When we wanted to use this oven to anneal a piece of casting, small castings of unequal thickness, they were taken from the sand as hot as they could be
256 handled and put into the oven, which had been previously heated by a fire built in the oven itself; this wasn't a constant practice; it was sometimes done; this oven was built for another specific purpose; the castings were left in this oven until cooled down, which was sometimes several hours.

Ques. 8. Where did you first, if ever, have any experience in the casting of iron car wheels, and what modes of annealing them did you know to be practised prior to 1847?

Ans. My first practical experience in casting car wheels commenced in 1852. I have worked in the shop where car wheels were cast in 1840, but they were not annealed; they were the split-hub wheels. Prior to 1347, I am not aware that I had seen any process of annealing car wheels; I don't recollect that I heard of any prior to that time.

Cross-examined by counsel for complainant:

Ques. 1. With whom did you learn your trade of iron founding?

Ans. I commenced it at Henry Stanley's, Poultney, Vermont, 1835. I worked at Johnson & Geer's, in Troy, New York, in 1838-'9. Then at Starbuck's, in Troy, from about 1839 to 1841. Then I was in the business at Worcester, Massachusetts, some eight months in 1842, I think it was; then I came back to Starbuck's (Troy, N. Y.) again for a year, 1843; then I came back to Albany as foreman for Vose & Co., for about three years and a half, 1844, 1845, 1846, to, I think, the latter part of 1847. Vose & Co. were stove-founders; they did some machinery casting the first year. Then I commenced business myself, with other parties—stoves and small jobbing work; this was in 1848-'9.

Ques. 2. Is not the treatment of chilled castings a distinct branch of the iron-founding art?

Ans. Yes, sir; it is.

Ques. 3. Is it not attended with difficulties not encountered in ordinary casting branches?

257 Ans. It is.

Ques. 4. Might not a process for treating ordinary castings prove inadequate for advantageous treatment of chilled castings?

Ans. In some respects it might.

Ques. 5. Have you described all the processes of annealing castings which you knew to be used prior to 1847, at Starbuck's, and elsewhere?

Ans. I think I have, to the best of my recollection now.

Ques. 6. Does Starbuck still carry on his business at Troy?

Ans. Yes, sir.

Ques. 7. In Mowry's process, as described in his patent, you say the pits are cold when the wheels are put in. Is this the case after the first wheel?

Ans. It would not be entirely cold after the first wheel.

Ques. 8. Would not the heat increase with each wheel and layer of charcoal, after the first?

Ans. No, sir; I think not.

Ques. 9. Would not the quantity of ignited fuel be greater with each additional layer of charcoal?

Ans. Yes, sir.

Ques. 10. Would not the increasing quantity of ignited fuel yield an increasing quantity of heat?

Ans. The temperature of the ignited charcoal would be lower than that of the wheel.

Ques. 11. Do you mean to say that a red heat of metal is greater than the heat of ignited charcoal?

Ans. I do; I know that from a series of experiments which I tried by packing wheels in charcoal, quite similar to Mowry's process. I inserted copper tubes down in the charcoal at the bottom of the pit, and filled the pit full of wheels and charcoal, replenished the charcoal as it burned away, with a free access of air through the hubs of the wheels, and free access of air to the coal at the top of the pit; I then tested the heat as it escaped from the tube by a thermometer, and likewise by inserting a vessel into the top of the tube, with a given quantity of water at a given temperature, and noticed the time it required to bring it to a boiling point, repeating this once in perhaps 10 or 15 minutes, for several hours. For the first half hour, perhaps, there was a rapid falling off of the heat. I repeated these experiments a great number of times, and found that invariably the case. I also tried other modes; I constructed a pyrometer which indicated a like falling off in the heat.

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Ques. 12. Do you not know that the white heat of metal is less than the heat of flame?

Ans. No; I think not.

Ques. 13. Did the tests you have mentioned prove that the wheels had lost heat, or simply that the fuel had not increased the heat of the castings?

Ans. That the wheels had lost heat.

Ques. 14. Did you try that experiment, or any similar one, with the top of the oven closed so as to prevent the escape of heat?

Ans. No; it was covered up deeply with ignited coal; no plates over it. I did try it covering the top with sand. I think it then indicated a slower escape of heat.

Ques. 15. Did you apply charcoal otherwise than to the rim or thin parts of the castings in 1844?

Ans. Yes, sir. I used it in making any hollow ware. I packed them in charcoal. I have packed all kinds of castings in charcoal since about 1844, and am still in the habit of doing so.

Ques. 16. Were any of these castings chilled prior to 1847?

Ans. Those along in 1844 were castings of hard iron. The rim was frequently crystallized and white, and as hard as when cast against a chill.

Ques. 17. When did you first see cast-iron car wheels made, and where?

Ans. At Starbuck's, (Troy, N. Y.,) about 1839.

Ques. 18. How were they treated after being cast?

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Ans. They were left to cool in the open air, with some portion of the sand left on that was used in moulding.

Ques. 19. What other modes of treating cast-iron car wheels were used prior to 1847, within your knowledge?

Ans. I am not acquainted, personally, with any.

Ques. 20. Did you see any car wheels annealed at Starbuck's, except as you have stated?

Ans. I don't recollect. There were many experiments tried on that. I am not positive as to the mode of treating them.

Ques. 21. Were the ordinary modes of treating ordinary castings tried on car wheels?

Ans. I don't recollect.

Ques. 22. Were car wheels annealed in the ovens, with iron doors, which you have described?

Ans. No, sir.

Ques. 23. As a practical and theoretical expert in the art of treating cast-iron car wheels, are you of opinion that the process of Mr. Whitney and the process of Mr. Mowry are substantially similar in principle, in mode of operation, and in effect, aside from the point to which, as you understand Mr. Whitney's claim, he raises the heat of his wheels, and taking the two processes otherwise, as each consisting of a mode of prolonging the time of cooling of the wheels?

Ans. Yes, sir; I think they are.

Ques. 24. Wherein?

Ans. Mr. Whitney's process, if carried out as set forth, destroys the chill of the wheels, while Mr. Mowry's process would not impair the chill at all. Respecting Mr. Whitney's, I know that such is the case. I have broken up many hundreds of his wheels that have been in use, and I have found frequently no chill in some parts of the wheel, when it was evident, from the deep chill in other parts, that the chill had been destroyed by the application of heat, and that if Mr. Whitney raises the heat to a point just below fusion, and maintains it there for thirty minutes, I think the chill would be so far destroyed as
260 to admit of turning, drilling, or filing with ordinary tools. I have tried many experiments myself in taking out the chill in a forge fire, and have never failed of destroying the chill in a very few minutes, without any indications of the iron melting.

Ques. 25. Have you not found imperfect wheels that have been treated by other processes than Mr. Whitney's?

Ans. Yes, sir; but not with the same effect on the chill.

Ques. 26. Are you now manufacturing car wheels, or have you ever made them as a part of your business?

Ans. No, sir; I am not, and never made them as a part of my own business. I have for George H. Thacher.

(Signed) LYSANDER A. ORCUTT.

Deposition of Noyes G. Green.

NOYES G. GREEN, being solemnly sworn, deposes and says:

Ques. 1. State your name, age, residence, and occupation.

Ans. I am (37) thirty-seven years old; my name is Noyes G. Green; I reside in Cincinnati; I am a mechanical engineer, and am at present engaged in superintending A. L. Mowry's car and wheel works, Cincinnati, Ohio.

Ques. 2. State what has been your experience and observation in the making and annealing of cast-iron car wheels.

Ans. I have been engaged in making and fitting cast-iron car wheels for twenty years, and have handled all the different patterns made in the United States, and have fitted a great many thousand pairs of wheels, in Massachusetts, Ohio, Michigan, Illinois, Indiana, and Missouri.

Ques. 3. State whether or not you have read and understand the letters-patent granted to A. L. Mowry, 7th day of May, 1861, a copy of which is now shown you, and whether or not you understand the pro-

cess as practised by A. L. Mowry, at his car and car-wheel works in Cincinnati.

261 Ans. I have read and do understand the letters-patent, and I perfectly understand the process under said patent, as practised at his car works, in Cincinnati.

Ques. 4. State whether or not you have read and understand the description of the Mowry process as contained in the deposition of George H. Knight, filed in this case, a copy of which is now shown you; and whether or not said description is correct; and if nay, point out where it differs from the process actually used at Mowry's car and car-wheel works.

Ans. I have read and do understand the said deposition. The said description is not correct in all respects. The proportion of the wheels to the size of the pit, as therein given, is not correct. The wheels in actual practice just fit into the pit, so as to pass into position without opposition from the sides of the pit, so that they will naturally slip down easy. In the next place, he represents charcoal as being covered all over the wheel. Our process is to put in about a third of a bushel, laid around upon the plate of each wheel between the hub and the rim, and no coal upon the outside, between the wall and the rim. There is an inch and a half difference between the diameter of the wheels and that of the pit, and we watch it to prevent coal getting between the wall and the wheel. If any does get there, we have a hook to pull it out. In Knight's description he says: "After the insertion of the first wheel, and, in fact, immediately upon such insertion, the furnace starts into active operation, and all the wheels after the first are manifestly inserted in an already heated furnace." And he says again: "Although Mowry's pits may be cold, or nearly so, immediately preceding the insertion of the first red-hot wheel, yet the instant that the wheel touches the bed of charcoal, it is enveloped in a body of flame and incandescent matter, but little inferior in heat to Whitney's illustration." In Mowry's process the charcoal does not ignite—not one-half—before the second wheel approaches it. The walls of the pit are not but a very little warmed until the pit is filled. The draught is entirely shut off

262 while the wheels are pitting, so that the coal does not ignite much. After the pits are filled with the complement of wheels, there is a cover that fits on top of the top layer of charcoal, and another cover is placed. All we aim to do is to just keep the coal alive. The coal does not all get fully ignited for several hours after the pit is filled.

Ques. 5. What is the relative heat of the different parts of the wheel, when placed in the Mowry pit?

Ans. The hub is the hottest, and the inside of the rim is second, the plate is the coolest.

Ques. 6. When the pit is filled how do the contained wheels cool?

Ans. They cool faster at the hub and treads than they do in the plate, on account of the cold current of air rapidly passing through the eye of the wheel and the cold walls of the pit, taking the heat from the tread. The charcoal being slowly ignited on the plate of the wheels, keeping the plate a little warmer than the tread, allows them to cool together; by so doing it relieves them from all strain.

Ques. 7. Have you examined, and do you understand the model now shown you, marked Respondent's Exhibit No. 7, and if yea, explain what it represents?

Ans. I have examined and do understand; it is a model of Mowry's annealing pit, made by workmen under my direction, from the specifications contained in the letters-patent of Mr. Mowry.

Ques. 8. State whether or not the pit with its contained wheels, correctly represent the originals in use at Mowry's works, Cincinnati, Ohio?

Ans. It correctly represents the annealing pits at A. L. Mowry's works. Theoretically there is a damper in the pipe, but practically there is a thin plate of iron regulating the admission of air through the pipe, placed on the top of the pipe.

Ques. 9. State what is the effect produced upon the wheels by the Mowry patent process.

263 Ans. We have carbonized them with charcoal, and relieved them of strain; that makes the plate both softer and tougher, making the plate nearly malleable; the plates can frequently be bent considerably before they will crack.

Ques. 10. State whether or not the temperature of the wheels placed in the pit is raised by the patent process of Mr. Mowry; if so, to what degree.

Ans. They are not raised to a temperature higher than when they are placed in the pit.

Ques. 11. State whether or not you have examined large numbers of car wheels made and annealed by Mowry, and by Whitney, by their patent processes respectively, to determine the effect produced thereby, and if you have found the effect produced by the two processes to differ the one from the other, explain said difference fully?

Ans. I have examined large numbers of wheels made by Whitney's process, and large numbers made by Mowry's process. There is considerable difference in the effect. In the Mowry process, the wheels show, when broken, clear, bright metal, and the Whitney process shows a darker, deadly cast of metal, when broken, and brittler in appearance and in trying as well, than the Mowry wheels. I have broken for this last three years, hundreds of the Whitney wheel that had been in use on railroads. In all cases I have found Whitney's wheels much easier broken. One blow of a drop, eighteen feet, of a six hundred pound drop, the Whitney wheel would most always fly in fragments in all directions, while the Mowry wheel, with the same drop, by the same process, would not often break at the first blow. Sometimes it would punch the hub out of the wheel and leave the plate sound. It would take as high as three blows, very often, to break a wheel so that it could be handled, and I have taken the fragments of the Mowry wheel often, to see if they would all come together in close joints, so as to make the wheel in its natural form, to see if it was relieved of all its strain; by that means it immediately shows if there was any

264 strain, and the parts of the wheel it was on. I found there was no strain, and the parts all fitted closely, making close joints. I have tried the Whitney wheel in the same way, and found that it would not come together in all parts and make a close fit, showing that the wheel was not relieved of its strain.

Ques. 12. Were the experiments you have just described upon Whitney and Mowry wheels made once, or more than once?

(Complainant objects to the preceding question and this one, as being irrelevant.)

Ans. I tried the experiment of joining the parts together three or four times, and always with the same result.

Ques. 13. State whether or not you have made experiments upon new car wheels, made respectively by the Whitney and Mowry patent processes, for the purpose of determining the effect produced by said processes; and if so, state what the results of your experiments are.

(Complainant objects to this question.)

Ans. On the 16th of April, 1866, we made a test of the strength of new Mowry and Whitney wheels, witnessed by Mr. Corey, superintendent of Niles Works, and Major Gwynn, gunboat inspector of U. S. service, with a 30-pound sledge striking in one place upon the plate; upon the seventh blow the Whitney wheel cracked, and the eleventh blow knocked one side of the plate off. On the Mowry wheel, trying in the same part of the wheel, on the nineteenth blow it knocked a hole through the plate the size of the sledge, not injuring the rest of the wheel.

Cross-examination by S. S. Fisher, complainant's counsel.

Ques. 1. In answer to question 10 of your examination-in-chief, in speaking of Mr. Mowry's process, you say: "The wheels are not raised to a temperature higher than when they are placed in the pit." Will you state what means you have taken to ascertain this, or whether your opinion, as expressed, is a mere matter of opinion.

265 Ans. In the first place there is a current of cold air rapidly passing through the eyes of the wheels, and a very light draft of cold air passing between the wheels and the pit, so that it all the time keeps cooling the heat of the wheel, and the tread does not get any hotter by that means. I have stayed there nights to watch the annealing of the wheels, to see if the pits worked all right, and found the wheels did not raise in temperature a bit. I have taken the tube out that goes into the eye of the wheel, and looked into the pit to ascertain the temperature of the wheels. I would also state that after the wheels come out of the annealing pit, the hooks on the wheels by which they are lifted, retained their white chilled appearance, and being thin, the chill would be taken out of them if they had been heated to a greater extent than they were when taken from the moulds. I would also state that if the wheels were heated to a greater degree than they were when taken from the moulds, they would show scales upon their surface after their removal from the annealing pit, and they do not show any such scales. Mowry's wheels are perfectly clean of sand when placed in the annealing pit.

(Signed) N. G. GREEN.

Reëxamined by defendant's attorney.

Ques. 1. You will please state the length of time required in the practice of the defendant's process for the entire combustion of the charcoal in the annealing pits.

Ans. About forty-eight (48) hours; I know this because I have taken the wheels out the next evening after they had been pitted, and found that the coal was not then consumed. I have also taken the wheels out the second evening after they were pitted, and found fire still on the plates.

Ques. 2. You will please state whether, in the practice of Mowry's process, you have an active or slow draft to supply combustion; and if your answer is that you have a slow draft, you will please state the length of time which would be required for the entire combustion of your charcoal, if you employed an active draft.

266 Ans. We have a very slow draft—just enough to keep the coal alive. Sometimes at the end of four days the charcoal is black upon the wheels, not yet consumed—having died out. If we employed an active draft, the charcoal would be consumed in about eighteen hours.

(Signed) N. G. GREEN.

Deposition of Robert Gwynn.

ROBERT GWYNN, being first solemnly sworn, deposes and says:

Ques. 1. State your name, age, residence, and occupation.

Ans. Robert Gwynn; aged 48 (forty-eight years;) residence, Seventeenth ward, Cincinnati, and am mechanical engineer.

Ques. 2. What has been your opportunities for becoming acquainted with the various branches of your profession, and especially with the art and science of iron founding and annealing of castings, both in Europe and America?

Ans. My father having been a mechanical engineer, practically engaged in the business at my birth; I may say that I have been conversant with these subjects from infancy; I served a regular apprenticeship to the business of construction of machinery, and have been engaged practically in the profession since 1832. I have had the superintendence of large establishments of the kind, both in this country and in Europe. My opportunities for observing the process of manufacture and annealing of castings have been extensive. The process most in use in the early part of my experience, was that of heating and enclosing in close ovens or boxes the articles to be annealed—usually enveloped in ashes or dry sand—anything that would certainly exclude the air; afterwards for large articles, such as car wheels, &c., what is known as the dry-sand process came into vogue, which consisted in placing the wheels, immediately after casting, while still hot, in pits, simply covering them with dry sand from the foundry floor.

267 Ques. 3. What has been your experience and observation in respect to the casting and annealing car wheels, and the use of the same?

Ans. I have had the superintendence of several of the principal railroads of the country, namely, the Ohio and Indiana, Lynchburg and Virginia, and was for a number of years engaged in the machine department of the Baltimore and Ohio Railroad; I was engaged as superintendent of the machine shops of the Berlin and Frankfort Railroad, Prussia, during which time I had many opportunities of observing the relative qualities of the wheels, and other castings of various constructors of such articles.

Ques. 4. Have you examined, and do you understand the process described in the letters-patent granted to Asa Whitney on the 25th of April, 1848, copy of which is now shown you?

Ans. I have read, and think I do understand it.

Ques. 5. Have you read, and do you understand respondent's Exhibits 1, 2, 3, 4, 5, 6, and 7, respectively, the same being now shown you?

Ans. I have read the exhibits, and believe I understand them.

Ques. 6. State whether or not the descriptions contained in those exhibits are sufficiently full, clear, and explicit to enable a person skilled in the art to which they relate, to reduce the processes respectively described to practice, and to carry the same into successful operation.

Ans. They are.

Question 6 objected to by plaintiff.

(Objection waived as far as it is legal.)

Ques. 7. State whether or not you find the processes described in the patent of Asa Whitney analogous and identical in the principles involved, and answer fully.

(Complainant objects to this question. Objection waived as far as it is legal.)

268 Ans. I do find the processes analogous; I find it in Exhibit 1, in these words: "The metal is kept for several hours at a temperature a little below its fusing point, and then allowed to cool slowly; in this manner vessels are made of cast iron which can sustain considerable violence without being broken. I find it in Exhibit 3, in these words: "When a substance, melted or nearly in a state of fusion, is cooled very hastily, its texture is so much altered, that if a ductile metal, it loses much of its malleability. To avoid this, the process of annealing is resorted to, which is nothing more than cooling the heated or melted substance as slowly and equally as possible, often in a separate furnace of the requisite heat, and sometimes called an annealing oven. A similar process is now used for rendering kettles and other vessels of cast iron less brittle." I find also, in Exhibit 4, the following: "In the manufactories in which the malleable metals are employed, annealing is used to soften the metal after it has been rendered hard by the hammer, and also to soften cast iron, which is rendered very hard and brittle by rapid cooling." I find in Exhibit 6, this: "A process is now used for converting cast iron into forged, by heat alone. The cast iron is placed in an air furnace, and kept for several hours in a degree of heat, by which it is brought near to a fluid state. It is then allowed to cool gradually, and is found to be converted into forged iron." Further, in reference to the casting of speculum metal, it is said: "The cast metal should be taken out from the sand of the flasks as soon as it has become solid, and while it is yet red hot, and the face must be kept downwards to keep it from sinking, holding it by the git; force out the sand from the middle of the mirror with a piece of wood or iron, and place the speculum in an iron pot, with a large quantity of hot ashes or small coals, so as to bury the speculum in them a sufficient depth. Let the speculum remain in the ashes till the whole is become quite cold."

Ques. 8. Please read carefully the article in Encyclopedia or Dictionary of Arts, &c., by Dobson, vol. 7, pp. 769, 770, 771, com-

269 mencing with the words "blowing the plates," and examine the plate, No. 220, annexed to such description, and state how the process therein described and illustrated, as applied to the annealing of glass, compares in principle, mode of operation, and effect, with the process of the complainant, as described in his letters-patent; and in giving your answer, you will please describe in detail the complainant's process, as understood by you, stating what difficulties or defects such process is intended to remedy in the wheels; and also describe the process, as understood by you, described in said Encyclopedia, and state what difficulties or defects such process is intended to remedy in the glass articles annealed.

(Objected to.)

Ans. I have read the article alluded to in the question, and so far as the principles involved, I find it to be identical with Whitney's process, as understood by me. In the specifications attached to Whitney's letters-patent, his process is described in the following words: "My improvement consists in taking railroad wheels from the moulds in which they are ordinarily cast, as soon after being cast as they are sufficiently cooled to be strong enough to move with safety, or before they have become so much cooled as to produce any considerable inherent strain between the thin and thick parts, and putting them in this state into a furnace or chamber that has been previously heated as high as that of the wheels when taken from the moulds. As soon as they are de-

posited in this furnace or chamber, the opening through which they have passed is closed, and the temperature of the furnace or chamber, and its contents, gradually raised to a point a little below that at which fusion commences, when all the avennes to and from the interior are closed, and the whole mass left to cool no faster than the heat it contains permeates through, and radiates from, the exterior surface of the materials of which it is composed." I find in the article referred to, section three, under the head "Casting or running of large mirror glass plates," that the liquid glass is allowed to flow upon the
270 casting table; this matter (the glass) is confined to certain dimensions by iron rules which are moveable, retain the fluid matter, and determine the width of the glass; these rules I take to be analogous to the chill in which the wheels are cast by Whitney's process, and the result from sudden cooling would, in this case, produce that inherent strain named in his letters-patent, to remove or obviate which in the case of the glass plate, would require a similar process, as in the case of the car wheel, and this process we find to be described in the article under consideration to be identical with that described in Whitney's letters-patent; for, having first set forth the fact of the necessity of the annealing, the article concludes in these words: "It need not here be observed that the carquaisses or annealing furnaces must first have been heated to the degree proper for them." In the same article, we find that the carquaisses or annealing furnaces, as soon as filled with the cast glass, are "stopped up with doors of baked earth, and every chink with cement, to let them anneal and cool again, which requires about fourteen days."

Ques. 9. You will please state whether or not, in your opinion, the description of the process of annealing, as contained in the article last referred to, and illustrated in the plate annexed thereto, is sufficiently clear to enable a person skilled in the art, to practise such process; if not, please state what element is lacking to complete the description.

(Objected to.)

Ans. I think that this article, with the plate, would be sufficient to enable one well skilled in the art, to accomplish the manufacture therein described; the only difficulty that I see being a failure on the part of the author minutely to describe the peculiar form of the annealing furnace, but any one at all familiar with the process of glass manufacture, would be at no loss to contrive an oven suitable for the annealing process.

Ques. 10. You will please state what is the operation and effect of said process, as described in said work, as to reheating or other-
271 wise, the articles after they are deposited in the annealing furnace, and if you should express the opinion that a reheating of these is contemplated, you will please give your reasons for such opinion.

Ans. I should suppose, from a perusal of the article, that a reheating is implied, though not definitely so expressed. The contact of the fluid glass with the table and iron rules, or borders, would necessarily be suddenly chilled or cooled. Crystallization taking place upon the external surface, thereby preventing the natural crystallization of the internal and still fluid parts, thus bringing an undue strain, an inherent strain upon the outer surface, to remove which evil it would be necessary to increase the temperature, so that by gradual and uniform cooling the whole mass might take or assume a crystalline form in a natural and gradual manner, which is really the philosophy of annealing anything. Glass and cast iron possess the property of expanding, or increasing in bulk, in passing from a fluid to a solid state. The fluid

glass coming in contact with the comparatively cold material of the table, which is sometimes stone and sometimes iron, is instantly crystallized, whilst the internal mass is as yet in a semi-fluid state, this internal portion cooling more gradually in its effort to obey this law of nature—that is, the increase in bulk presses with great force upon its already crystallized envelope, which is the outside covering, thereby producing a strain which, if not sufficient to rend it, must, in all cases, very nearly approximate that result, and this state of tension can only be removed by reheating and gradually cooling, thus allowing, as before stated, the whole mass to crystallize uniformly.

Ques. 11. In the letters-patent of complainant the following words occur: "The temperature of the furnace, or chamber, and its contents is gradually raised to a point a little below that at which fusion commences." You will please state how, in view of this language, you would proceed in practising the complainant's process as to heating the wheels in the annealing furnace.

(Objected to.)

272 Ans. The readiest mode, to my mind, would be to have a peep or spy hole in the furnace, so that I could judge by my eye when the point of fusion of the wheels contained within the furnace was nearly reached; of this I would be able to judge by the peculiar greasy appearance of the heated metal, and the scintillations given off by the small fins and projections adhering to the wheels, which would naturally fuse first, and when they began to fuse I would think the metal was nearly at the fusing point.

Ques. 12. You will now please to state what would be the effect upon the "chill," if the car wheels were heated to "a point a little below that at which fusion commences."

Ans. The effect would be to deteriorate the chill, to how great an extent I am unable to say, never having experimented upon that point, but reasoning upon the conceded fact that like cause produces like effect, this result may be inevitable—that is, the deterioration of the chill, because if long kept in a degree of heat near the fusing point, the whole wheel would be converted into malleable iron, as is demonstrated in the process of the manufacture of that material. If this process, long continued, will produce that effect, then it follows that a shorter continuance would produce the same effect in less degree.

Ques. 13. About how many degrees difference is there between a "red" or "cherry-red" heat, and a white heat, in an iron casting, such as a car wheel?

Ans. I am not prepared to say from memory, but any of the handbooks would give satisfactory information on the subject; but my present impression is that there is a difference of a thousand degrees of heat between "cherry-red" and white heat.

Q. 14. Will a wheel begin to fuse before or after the metal has reached a white heat.

Ans. It will begin to fuse at just about that point, when it reaches a white heat, it is just about the point of fusing—cast iron won't bear its own weight when it is white hot.

273 Ques. 15. What means, if any, are provided in complainant's patent, for ascertaining when the annealing furnace has been heated to the temperature stated in the patent to be necessary?

Ans. I am not aware of any being stated in the patent.

Ques. 16. In answer to question 10, you state that, in your opinion, the article therein referred to, describes a process of reheating in the

annealing furnace, and you give one reason for your opinion; if you have other reasons for your opinion, please state them fully.

Ans. I am further strengthened in that opinion by the text of the article referred to, wherein after describing the process of placing the plates in the annealing oven, "and stopping them (the ovens) up with doors of baked earth, and every chink with cement, as soon as they are full, to let them anneal and cool again," which second cooling does, in my opinion, involve the necessity of a second heating. And further, I would say, the article expressly states that it requires fourteen days for the plates to cool, which would not be the case if their temperature had not been raised above the point at which they were when taken from the casting table.

Ques. 17. What would be the effect on a car wheel treated by the process described in the article you have just referred to, compared with the effect produced on the same kind of a car wheel treated by the process described in Mr. Whitney's letters-patent. Please describe any differences in effect produced fully.

Ans. There would be no difference in the results, and if any, the difference would be in favor of the process described in the article referred to, because by Whitney's process the wheel would be subjected to an intense heat, a little below the fusing point; which, as I have already stated, in my opinion, would deteriorate the chill, whilst in the process described in the article referred to, the wheels would not be subjected to that intense heat, and the slow process of cooling (14 days) would more effectually anneal and strengthen. By this, I
274 mean to say, there would be practically no difference between the two processes in result, but might be in degree.

Ques. 18. To what degree of temperature would one skilled in the art of iron founding and annealing raise the temperature of the annealing furnace, if, in so doing, he was guided by the directions given in the letters-patent of Mr. Whitney?

Ans. From twenty-five hundred to twenty-eight hundred degrees. Iron melts at about twenty-eight hundred degrees—all irons are not alike; some irons melt easier than that, and some probably later.

(Signed) ROBERT GWYNN.

Since giving my answer to the 13th question, I have examined authorities upon the subject, and find it laid down in the Encyclopedia of Useful Arts, published by George Virtue & Co., in London, 1854, that cast iron melts at 2,786 degrees, and a bright or orange red-heat of iron is 1,873 degrees—thus making the difference between the point of fusion and red heat 913 degrees.

(Signed) ROBERT GWYNN.

Cross-examination of Robert Gwynn by complainant's counsel, S. S. Fisher:

Ques. 1. Have you had any actual experience in the annealing of car wheels, except the ordinary?

Ans. I have not.

Ques. 2. Are you the same Robert Gwynn who gave a deposition in a former case between these same parties?

Ans. I am.

Ques. 3. State, if in that deposition you were asked the following question, and made the following answer: "Wherein, in your judgment, do the processes of the complainant and the defendant differ?"

"In this, that in the Whitney process the furnace is previously
275 heated, whilst in the Mowry process the pit is not previously heated, but the charcoal is ignited from the heat contained in the wheel itself, at the time it is deposited in the pit. I think there would be no difference in effect, except in so far as the charcoal strengthens the iron by imparting to it carbon."

Ans. I was asked the question, and did make the answer.

Ques. 4. Is that still your opinion?

Ans. It is still my opinion.

Ques. 5. Do I understand you to say that, from the analogy between glass and iron cast with a chill, that an undue strain, or inherent strain is produced upon the outer surface, to remove which evil it is necessary to increase the temperature, so that by gradual and uniform cooling the whole mass might take or assume a crystallized form in a natural and gradual manner?

Ans. An increase of temperature would be necessary, providing the mass had cooled to a temperature below that at which the natural adjustment of the particles takes place. If the temperature was not reduced below that point, a long continuance at that temperature would alone be necessary. If the temperature, however, had been reduced below that point, then I mean to say that an increased temperature would be necessary.

Ques. 6. Do you not fail to specify these conditions in your answer to the 10th direct question, when you say that a reheating is implied in the article from Dobson's Encyclopedia, because of the rapid cooling of the external surface in glass and analogous substances, cast with a chill. Please examine that answer.

Ans. No; because it is stated in the text that after filling the carquaisse, and "stopping them up with doors of baked earth, and every chink with cement, as soon as they are full, to let them anneal and cool again, which requires about fourteen days." The "cooling again" would imply, in my opinion, a former cooling, and necessarily a second heating. And then, besides, from the nature of things, the entire surface of the plate, being exposed upon one side to the cooling effect of the atmosphere, and upon all its edges and other side, to the cooling
276 effect of the iron of the table, would necessarily be reduced almost instantaneously to a solid condition, the effect of which would be to produce that undue strain, as explained in my answer to direct question No. 10, and which condition could only be removed by reheating, or keeping the glass at a high temperature a sufficient length of time to allow a natural disposition of its particles.

Ques. 7. What is the purpose of allowing the glass to remain in the oven two weeks?

Ans. To allow the particles gradually to assume their natural condition; and I presume the process is continued this great length of time to insure that result. Some authorities name a less time, and possibly experience would demonstrate a less time to be sufficient for the purpose.

Ques. 8. How long a time is necessary for converting cast iron into forged, by the annealing process?

Ans. No length of time would be adequate by the simple process of annealing, to impart to cast iron the laminated structure of wrought iron, but all its other properties may be imparted in about thirty-six to forty-eight hours; much would depend upon the size of the article subjected to the process.

Ques. 9. Then you do not agree with this statement on page 40 of

the second volume of Dobson's Encyclopedia: "The surface soon becomes lamellated like forged iron." "When it is continued for a sufficient time, and then allowed to cool gradually, it is found to possess the lamellated structure throughout."

Ans. I do not. Hammering or rolling is necessary to produce that structure.

Ques. 10. Then you think the structure of forged iron cannot be imparted to cast iron, notwithstanding the authorities upon that point—is that so?

Ans. Completely, I do not. I have never seen a piece of malleable iron—by which I mean to say cast iron—long subjected to the
277 annealing process, that had the laminated structure of rolled or forged iron, or possessed the welding property of that article.

Ques. 11. Have you any experience upon the subject of the last two questions?

Ans. Only that of reading and observation, never having been personally engaged in the manufacture of what is usually known as malleable cast iron.

Ques. 12. Is there anything said in the article from Dobson, about the application of the process, or the modifications necessary to apply it to the manufacture of chilled metallic castings of any description, and especially of railroad car wheels? If so, please point it out.

Ans. I find nothing in said article having special reference to the manufacture of chilled articles of any kind, but I do find specific directions for removing the chill after it has been naturally imparted by rapid cooling—this direction being applied specially to the annealing of glass.

Ques. 13. It is no part of Whitney's or Mowry's process to remove the chill of railroad car wheels, is it?

Ans. No, sir.

Ques. 14. When you say that the process described in Dobson is analogous to that described in Whitney's patent, you mean nothing more, if I understand you, than that Dobson describes a process for the treatment of glass analogous to that described by Whitney for the treatment of car wheels, except that Dobson does not describe the form of his oven, and does not distinctly declare that the glass is to be reheated, though you think that is implied. Am I right?

Ans. You are right.

Ques. 15. What kind of a pit or chamber would you construct if you wished to melt ten car wheels, placed in a pile, one upon the other?

Ans. If I desired to do it in the most rapid and effectual manner, I would construct a pit after the manner of an ordinary cupola,
278 placing a sufficiency of fuel at the bottom of the pit—upon it a wheel, over that another wheel, and so on until all the wheels were placed within the pit, and entirely enveloped in fuel. I would then apply a powerful blast at the bottom of the pit, as in the cupola; which operation, I think, would result in melting them effectually.

Ques. 16. Suppose ten wheels placed in a cylindrical pit one above the other, a cover placed upon the pit, a fire built upon a grate surrounding the lower wheel but below it, the damper in the flue leading to the chimney being closed, and the opening to the lower portion stopped—what do you think of the chances of melting the wheels in such an apparatus?

Ans. Under those circumstances, as named in the question, it could not be done.

Ques. 17. Could you even heat them, so as to impair the chill, if in

such an apparatus they passed from the hot to the cold stage in three days?

Ans. Under those circumstances of course you could not.

Reëxamined by defendant's attorney:

Ques. 1. Do you infer from the complainant's patent that, immediately after the wheels are placed in the annealing furnace, the damper in the flue leading to the chimney is closed, and the opening to the lower portion stopped? If you infer the contrary of this, give your reasons for so thinking.

Ans. I do not so infer, because it is stated in the specifications accompanying the letters-patent that, before the wheels are placed in the furnace, "it has been previously heated to a temperature as high as that of the wheels when taken from the moulds." "As soon as they are deposited in this furnace, or chamber, the opening through which they have been passed is closed, and the temperature of the furnace, or chamber, and its contents, gradually raised to a point a little below that at which fusion commences, when all the avenues to and from the interior are closed, and the whole mass left to cool no faster than
279 the heat it contains permeates through and radiates from the exterior surface of the materials of which it is composed."

Recross-examination by conplainant's counsel:

Ques. 1. Look at the apparatus shown in Whitney's patent, and state whether it would be possible, in your opinion, to melt wheels in such a furnace, or to raise them to near the melting point without the use of a powerful blast?

Ans. Without the use of a powerful blast, I do not think that it would be possible to melt them or raise them near the melting point, unless the natural draft was very great, and the damper kept open. Under those circumstances, acting as an air furnace, it might be possible, but I would consider it difficult.

(Signed) ROBERT GWYNN.

Respondent's Exhibit, No. 1.—*Thornton M. Hinkle, special examiner.*

280 A Dictionary of Arts, Manufactures, and Mines, containing a clear exposition of their principles and practice. By Andrew Ure, M. D., F. R. S., M. G. S., M. A. S., Lond.; M. Acad., N. S. Philad.; S. Ph. Soc., N. Germ., Hanov., Mulü, etc., etc. Illustrated with twelve hundred and fifty engravings on wood. From the second London edition. New York: La Roy Sunderland, 126 Fulton street, 1842.

ANNEALING OR NEALING.—(*Le recuit*, Fr.; *dans antassen*, Germ.)—A process by which glass is rendered less frangible, and metals which have become brittle, either in consequence of fusion or long-continued hammering, are again rendered malleable. When a glass vessel is allowed to cool immediately after being made, it will often sustain the shock of a pistol bullet, or any other blunt body falling into it from a considerable height, while a small splinter of flint, or an angular fragment of quartz, dropped gently into it, makes it, sometimes immediately, sometimes after a few minutes, fly to pieces with great violence. This extreme fragility is prevented by annealing, or placing the ves-
281 sels in an oven, where they take several hours, or even some days, to cool. Similar phenomena are exhibited in a higher degree by glass tears, or Prince Rupert's drops. They are procured by letting drops of melted glass fall into cold water. Their form resembles that

of a pear, rounded at one extremity and tapering to a slender tail at the other. If a part of the tail be broken off, the whole drop flies to pieces with a loud explosion; and yet the tail of a drop may be cut away by a glass-cutter's wheel, or the thick end may be struck smartly with a hammer without the fear of sustaining any injury. When heated to redness, and permitted to cool gradually in the open air, they lose these peculiarities, and do not differ sensibly from common glass.

The properties of unannealed glass depend on a peculiar structure, extending uniformly through its whole substance, and the bursting of a glass drop by breaking off the tail, or of an unannealed glass vessel, by dropping a piece of flint into it, arises from a crack being thus
282 begun, which afterwards extends its ramifications in different directions throughout the glass.

When metals have been extended to a certain degree under the hammer, they become brittle, and incapable of being further extended without cracking. In this case the workman restores their malleability by annealing or heating them red hot. The rationale of this process seems to be that the hammering and extension of the metal destroy the kind of arrangement which the particles of the metal had previous to the hammering; and that the annealing, by softening the metal, enables it to recover its original structure.

Of late years a mode has been discovered of rendering cast iron malleable without subjecting it to the action of puddling. The process is somewhat similar to that employed in annealing glass. The metal is kept for several hours at a temperature a little below its fusing point, and then allowed to cool slowly. In this manner vessels are made of cast iron, which can sustain considerable violence without being broken. See Steel, softening of.—(Article, Annealing or nealing, pages 53, 54.)

283 Stir with a wooden rod as long as arsenical fumes rise, and then pour it into a sand mould. While still red hot, lay the metal in a potfull of very hot embers, that it may cool very slowly, whereby the danger of its cracking or flying into splinters is prevented.—(Article, Copper, page 339.)

Respondent's Exhibit, No. 2.—Thornton M. Hinkle, special examiner.

The Artist's and Mechanic's Repository, and Workingman's Informant, embracing chemistry, abstracts of electricity, galvanism, magnetism, mechanics, phneumatics, optics, and astronomy; also, mechanical exercises in iron, steel, lead, zinc, copper, and tin soldering, with a description of the slide rule, its definitions and examples, illustrating every manner of its use, which is applicable to every mode of measurement, and to all the mechanical powers; also, a variety of useful receipts, extending to every profession and occupation in life,
284 and embracing practical subjects, the major part being original, and the remainder selections from the best authorities. In addition to which miscellanies is a valuable collection of practical receipts in dying silk, woolen, cotton, and leather. By James Pilkington. Philadelphia: Published by Michael Kelly, No. 341 Market street, 1840.

The heat applied to cast iron previously to its being plunged into the water to harden, is greater than that to which steel is subjected for the same purpose. Cast iron, also, when once hardened, admits not, like steel, of that hardness being reduced by various gradations to any

specific degree. To soften it materially, it must be submitted for some time to a complete ignition and very gradually cooled.

AN'EALING.—In a considerable number of instances, bodies which are capable of undergoing ignition are rendered hard and brittle by sudden cooling. Glass, cast iron, and steel are most remarkably affected by this circumstance; the inconveniences arising from which are
285 obviated by cooling them very gradually, and this process is called annealing. Glass vessels are carried into an oven over the great furnace called the leer, where they are permitted to cool in a greater or less time, according to their thickness and bulk. Steel is most effectually an'ealed by making it red hot in a charcoal fire, which must completely cover it and be allowed to go out of its own accord. Cast iron, which may be annealed in too large a quantity to render the expense of charcoal very agreeable, may be heated in a cinder fire, which must completely envelope and defend the pieces from the air till they are cold. The fire need not be urged so as to produce more than a red heat; a little beyond this, bars and thin pieces would bend if destitute of a solid support, and would even be melted without any vehement degree of heat. If it be required to an'eal a number of pieces expeditiously, and the fire is not large enough to take more than one or two of them at once, or if it be thought hazardous to leave the fire to itself, from an apprehension that the heat might increase too much, the following scheme may be adopted: Heat as many of the pieces at once as may be convenient, and as soon as they are red hot, bury
286 them in the dry sawdust. Cast iron, when an'ealed, is less liable to warp by a subsequent partial exposure to moderate degrees of heat than that which has not undergone this operation.—(Articles, iron and annealing, pages 281, 282.)

Respondent's Exhibit, No. 3.—Thornton M. Hinkle, special examiner.

The American Artists' Manual, or Dictionary of Practical Knowledge in the Application of Philosophy to the Arts and Manufactures. Selected from the most complete European systems, with original improvements and appropriate engravings, adapted to the use of the manufacturers of the United States. By James Cutbush. In two volumes. Vol. 1. Philadelphia: Published by Johnson & Warner, and R. Fisher. W. Brown, printer, Church alley, 1814.

ANNEALING.—When a substance melted, or nearly in a state of fusion, is cooled very hastily, its texture is so much altered, that, if a ductile metal, it loses much of its malleability and cannot be extended
287 far under the hammer without cracking; or, if a brittle metal, a glass or vitrescent mixture, it is liable to fly to pieces by a very slight change of temperature or external injury. To avoid this, the process of annealing is resorted to, which is nothing more than cooling the heated or melted substance as slowly and equally as possible—often in a separate furnace of the requisite heat, and sometimes called an annealing oven. The utility of annealing is shown very conspicuously in the manufacture of glass, the casting of speculum metal, or the beating of gold.

The difference between unannealed and annealed glass is very remarkable. When a glass vessel that has not undergone this process is broken, it often flies into a small powder with a violence apparently disproportionate to the stroke which it received. In general, it is in greater danger of being broken from a very slight blow than from a

more considerable one. Such a vessel will often resist the effects of a pistol bullet dropt into it from the height of two or three feet, yet a grain of sand falling into it will break it into small fragments. This sometimes takes place immediately on dropping the sand into it,
288 but the vessel will frequently remain apparently sound for several minutes after, when, without the least touch, it will suddenly fly to pieces. If the glass be very thin, this effect does not take place; and, on the contrary, it seems to possess all the properties of such as are annealed.

Glass is one of those bodies which increase in bulk on passing from a fluid to a solid state. When it is allowed to crystallize regularly, the particles are so arranged that it has a fibrous texture; but when a mass of melted glass is suddenly exposed to a cold temperature, the surface crystallizes and forms a firm shell round the interior fluid parts, by which they become solid, and are prevented from expanding.

By the process of annealing, the glass is preserved for some time in a state approaching to fluidity; the heat increases the bulk of the crystallized part, and renders it so soft that the internal fibres have an opportunity of expanding and forming a regular crystallization.

A similar process is now used for rendering kettles and other vessels of cast iron less brittle, which admits of the same explanation as that above stated. The greater number of metals diminish when
289 they pass from a fluid to a solid state. Iron, on the contrary, expands.—(Vol. 1 . aling.)

Respondent's Exhibit, No. 4.—*Thornton M. Hinkle, special examiner.*

The Encyclopædia Britannica, or Dictionary of Arts, Sciences, and General Literature. Seventh edition, with preliminary dissertations on the history of the sciences, and other extensive improvements and additions; including the late supplement, a general index, and numerous engravings. Volume III. Adam and Charles Black, Edinburgh, MDCCCXLII.

Annealing, by the workmen called nealing, is a process used in glass making, and in the manufacture of certain metals. In glass making it consists in placing the bottles, &c., whilst hot, in a kind of oven or furnace, where they are suffered to cool gradually. They would otherwise be too brittle for use. The difference between unannealed and annealed glass, with respect to brittleness, is very remarkable. When an unannealed glass vessel is broken, it often flies into a small
290 powder, with a violence seemingly very unproportioned to the stroke it has received. In general it is in greater danger of breaking from a very slight stroke than from one of some considerable force. One of these vessels will often resist the effects of a pistol bullet dropt into it from the height of two or three feet; yet a grain of sand falling into it will make it burst into small fragments. This takes place sometimes immediately on dropping the sand into it; but often the vessel will stand for several minutes after, seemingly secure; and then, without any new injury, it will fly to pieces. If the vessel be very thin, it does not break in this manner, but seems to possess all the properties of annealed glass.

The same phenomena are still more strikingly seen in glass drops or tears. They are globular at one end, and taper to a small tail at the other. They are the drops which fall from the melted mass of glass on the rods on which the bottels are made. They drop into the tubs of

water which are used in the work; the greater part of them burst immediately in the water. When those that remain entire are examined, they discover all the properties of unannealed glass in the high-
291 est degree. They will bear a smart stroke on the thick end without breaking; but if the small tail be broken, they burst into small powder with a loud explosion. They appear to burst with more violence, and the powder is smaller, in an exhausted receiver, than in the open air. When they are annealed they loose these properties.

Glass is one of those bodies which increase in bulk when passing from a fluid to a solid state. When it is allowed to crystallize regularly, the particles are so arranged that it has a fibrous texture. It is elastic, and susceptible of long-continued vibrations; but when a mass of melted glass is suddenly exposed to the cold, the surface crystallizes, and forms a solid shell round the interior fluid parts. This prevents them from expanding when they become solid. They, therefore, have not the opportunity of a regular crystallization, but are compressed together with little mutual cohesion. On the contrary, they press outward to occupy more space, but are prevented by the external crust. In consequence of the effort of expansion in the internal parts,
292 the greater number of glass drops burst in cooling, and those which remain entire are not regularly crystallized. A smart stroke upon them communicates a vibration to the whole mass, which is nearly *ch*ynchronous in every part; and, therefore, the effort of expansion has little more effect than if the body were at rest; but the small tail and the surface only are regularly crystallized. If the tail be broken, this communicates a vibration along the crystallized surface, without reaching the internal parts. By this they are allowed some expansion; and, overcoming the cohesion of the thin outer shell, they burst it, and are dispersed in powder.

In an unannealed glass vessel the same thing takes place. Sometimes the vibration may continue for a considerable time before the internal parts overcome the resistance. If the vessel be very thin, the regular crystallization extends through the whole thickness, or at least the quantity of compressed matter in the middle is so inconsiderable as to be inca*b*able of bursting the external plate.

293 By the process of annealing the glass is kept for some time in a state approaching to fluidity; the heat increases the bulk of the crystallized part, and renders it so soft that the internal parts have the opportunity of expanding and forming a regular crystallization.

In the manufactures in which the malleable metals are employed, annealing is used to soften a metal after it has been rendered hard by the hammer; and also to soften cast iron, which is rendered very hard and brittle by rapid cooling.

In the manufacture of steel goods, which are first formed by the hammer, and require to be filed or otherwise treated, and in which softness and flexibility are essential to the change, annealing is absolutely necessary. This is particularly the case in making files and scissors, that the metal may be left sufficiently soft for cutting the teeth, and for filing off those parts which cannot be ground. Annealing is not less necessary in the drawing of wire, whether iron, copper, brass, silver, or gold. The operation of drawing soon gives the wire a degree of
294 hardness and elacticity which, if not removed from time to time by annealing, would prevent the extension of the wire, and render it extremely brittle. The same operation is also necessary in rolling or flatt'ing those metals which are in a cold state, such as brass, silver, gold, &c. The brazier who forms vessels of copper and brass by the

hammer, can work upon it only for a little time before he is obliged to anneal it.

The common methods employed for annealing iron and steel are very injudicious, and materially injure the latter when it is used for making cutting instruments. After they have been formed by the hammer, they are generally piled up in an open fire, slowly raised to red heat, and then allowed as gradually to cool. By this method, the surface of the steel will be found considerably scaled, from the action of the oxygen of the atmosphere. When it is remembered that steel consists of iron joined to carbon, it will be evident that the steel, immediately under the scaly oxide, will be deprived of its carbon, which has been carried off by the attraction of the oxygen; and, in consequence, will loose the property of acquiring that degree of hardness necessary to a cutting instrument.

Nothing, therefore, can be more obvious than that steel particularly should be annealed in close vessels, to prevent that effect. For this purpose, the goods should be placed in a trough or recess made of fire stone or fire brick, and stratified with ashes or clean sand, and finally covered with a thick stratum of the same; but if the size of the vessel be small, it may have a cover of its own materials. This oven or trough must now be heated by the flame of a furnace passing under and round it till the whole is of a red heat. It must then be suffered to cool without letting in the air. The goods so treated will be much softer than by the common method. The surface, instead of becoming scaled, will have acquired a metallic whiteness, from the presence of a small quantity of carbonaceous matter contained in the ashes in which they were imbedded. They will become so flexible, also, as to allow them to bend considerably without breaking, which is very far from being the case before the operation. The fracture, before annealing, will be smooth and short; but afterwards it will be rough, exhibiting bright parts of a crystalline appearance. Wire, especially that of iron and steel, should be treated in a similar way when it is annealed. The wire used for some purposes requires to be soft, and is sold in that state. If the wire, after finishing, when it is bright and clean, were to be annealed in contact with oxygen, it would not only lose all its lustre and smoothness, but much of its tenacity. The process above mentioned will, therefore, be particularly necessary in annealing finished wire, as well as in softening it from time to time during the drawing.

Copper and brass suffer much less than iron and steel from annealing in the open air, and do not require to be heated above a low red heat. If, however, the lustre is to be perserved, a close vessel would be desirable. The latter metals, after annealing, although much discolored by the oxygen of the atmosphere, may be cleansed by immersion in a hot liquor composed of water and a small quantity of sulphuric or nitric acid. Very small brass or copper wire is frequently annealed by exposing it to the flame of hay or straw. In casting minute pieces of pig iron, which is generally done in wet sand, the metal possesses the property of steel to such a degree as to assume, by the rapid cooling, a degree of hardness equal to hardened steel; at the same time that the articles are so brittle as to break by falling on the ground. When, however, these goods are treated in the way above directed, they acquire a degree of softness which renders them penetrable by the file, and at the same time, capable of bending. In this state they are much less tenacious then steel; but still so much so as

to have been sold in the form of cutlery for steel.—(Vol. 3, pages 196, 197, Article, Annealing.)

The bottle is then lifted by the neck on a fork, by a little fellow about ten years of age, and carried to the annealing arch, where the bottles are placed in bins above one another. This arch is kept a little below melting heat, till the whole quantity, which amounts to ten or twelve gross in each arch, is deposited, when the fire is allowed to die
298 out.—(Vol. 10, page 579, see Article, Glass, vol. 10, pages from 562 to 579, inclusive.)

Respondent's Exhibit No. 5.—Thornton M. Hinkle, special ex'r.

Annealing or nealing, as it is called by the workmen, is a process particularly employed in the glass-houses, and consists in putting the glass vessels as soon as they are formed, and while they are yet hot, into a furnace or oven, not so hot as to remelt them, and in which they are suffered to cool gradually. This is found to prevent their breaking so easily as they otherwise would, and particularly on exposure to heat. There is also this difference between annealed and unannealed glass; that when the latter is broken it often flies into small powder, as is remarkably exemplified in the little glass bubbles sold in the streets & called Prince Rupert's drops, which are drops of common bottle glass, which fall from the rods on which bottles are made into water, which suddenly cools them. (See Rupert's drops.)

Various theories have been started to account for the phenom-
299 ena, but none of them quite satisfactory, and all that can be said is that by gradually cooling the glass becomes perfectly crystallized.

A similar process is used for rendering cast-iron vessels less brittle, and the effect probably depends on the same principles.

(Gregory's Dictionary, part 1, vol 1, title Annealing or Nealing (page not numbered,) published in 3 vols., by Isaac Peirce, 316 Market st., Philad'a, A. D. 1816.)

Respondent's Exhibit No. 6.—Thornton M. Hinkle, special examiner.

ANNEALING.—Annealing of glass, by the workmen called nealing, consists in placing the bottles, &c., whilst hot, in a kind of oven or furnace, where they are suffered to cool gradually; they would otherwise be too brittle for use. Metals are rendered hard and brittle by hammering; they are therefore made red hot in order to recover their malleability, and this is called nealing.

* * * * * *

300 By the process of annealing, the glass is kept for some time in a state approaching to fluidity; the heat increases the bulk of the crystallized part, and renders it so soft that the internal parts have the opportunity of expanding and forming a regular crystallization.

A similar process is used for rendering kettles and other vessels of cast iron less brittle.

* * * * * *

A process is now used for converting cast iron into forged, by heat alone. The cast iron is placed in an air furnace, and kept for several hours in a degree of heat, by which it is brought near to a fluid state. It is then allowed to cool gradually, and is found to be converted into forged iron.

* * * * * *

The cast metal should be taken out from the sand of the flasks as soon as it has become solid, and while it is yet red hot, and the face must be kept downwards to prevent it from sinking, holding it by the git, force out the sand from the middle of the mirror with a piece of wood or iron, and place the speculum in an iron pot with a large
301 quantity of hot ashes or small coals, so as to bury the speculum in them a sufficient depth.

Let the speculum remain in *in* the ashes till the whole is become quite cold.

Respondent's Exhibit No. 7—Thornton M. Hinkle, special examiner.

"2. BLOWING THE PLATES.—The work-houses, furnaces, &c., used in the making this kind of plate glass are the same, except that they are smaller, and that the carquaisses are disposed in a large covered gallery, over against the furnace, as those in the following article, to which the reader is referred." * * * * * *

"For the last time they put the pontil on the tressel that the glass may become red hot, and the workman cuts it quite open with his shears. * * "In the mean time the man who looks after the carquaisses comes to receive the glass upon an iron shovel two feet and a half long without the handle and two feet wide, with a small border of an inch and a half to the right and left, and towards the handle of the
302 shovel. Upon this the glass is laid. * * The glass is then removed to the mouth of the hot carquaisse where it becomes red hot gradually; the workman with an iron tool six foot long widened at the end in the form of a club at cards four inches long, and two inches wide on each side, very flat, and not half an inch thick, gradually lifts up the cut part of the glass to unfold it out of its form of a flattened cylinder, and render it smooth by turning it down upon the hearth of the carquaisse. * * When the glass is thus made quite smooth it is pushed to the bottom of the carquaisse or annealing furnace with a small iron raker, and ranged there with a little iron hook. When the carquaisse is full, it is stopped and cemented as in the case of run glasses, and the glass remains there for a fortnight to be annealed, after which time they are taken out to be polished.

* * * * * * *

CASTING OR RUNNING OF LARGE MIRROR GLASS.

"3. Plate CCXX. PLATES.—The furnace is of a very large dimension, environed with several ovens, or annealing furnaces, called
303 carquaisses. This furnace, before it is fit to run glass, costs £3,500. It seldom lasts above three years, and, even in that time, it must be refitted every six months. The melting pots are as big as a large hogshead, and contain about 2,000 weight of metal. If one of them bursts in the furnace, the loss of the matter and time amounts to £250. The materials in these pots are the same as described before. When the furnace is red hot, these materials are put in at three different times, because that helps the fusion, and in 24 hours they are refined, vitrified, settled, and fit for casting. A is the bocca or mouth of the furnace. B is the cistern that conveys the liquid glass it receives out of the melting pots in the furnace to the casting table. These cisterns are filled in the furnace, and remain therein six hours after they are filled, and then are hooked out by means of a large iron chain guided by a pulley placed upon a carriage with four wheels marked C, by two men. This carriage has no middle piece, so that when it has

304 brought the cistern to the casting table D, they flip off the bottom of the cistern, and out rushes a torrent of flaming matter upon the table; this matter is confined to certain dimensions by the iron rulers E E, which are moveable, retain the fluid matter, and determine the width of the glass, while a man, with the roller F resting on the edge of the iron rulers, reduceth it as it cools to an equal thickness, which is done in the space of a minute. This table is supported on a wooden frame, with tressels, for the convenience of removing to the annealing furnace, into which, strewed with sand, the new plate is shoved, where it will harden in about ten days.

"What is most surprising throughout the whole of this operation, is the quickness and address wherewith such massy cisterns, filled with flaming matter, are taken out of the furnace, conveyed to the table, and poured therein, the glass spread, &c.

"As fast as the cisterns are emptied they carry them back to
305 the furnace and take fresh ones, which they empty as before. This they continue to do as long as there are any full cisterns, laying as many plates in each carquaisse as it will hold, and stopping them up with doors of baked earth, and every chink with cement, as soon as they are full, to let them anneal and cool again, which requires about 14 days.

"The cisterns at each running should remain at least six hours in the furnace to whiten; and when the first annealing furnace is full, the casting table is to be carried to another. It need not here be observed that the carquaisse or annealing furnace must first have been heated to the degree proper for them." * * * *

(Encyclopædia, etc. Philadelphia: Printed by Thomas Dobson, at the Stone-house, No. 41 South Second street, MDCCXCVIII. Volume 7, plate CCXX, pages 769, 770, and 771.)

306 Cir. c't U. S. southern dist. of Ohio.

STATE OF OHIO, *Hamilton County:*

ASA WHITNEY, COMP'T, }
vs. } 534.
A. L. MOWRY, DEF'T. }

The complainant will take notice that, on Thursday, the 17th day of January, A. D. 1867, the def't above named will take the depositions of sundry witnesses to be used as evidence on the trial of the above cause, at the law office of Ja's P. Brown, esq., in the city of Pittsburgh, in the county of Allegheny, in the State of Pennsylvania, between the hours of eight o'clock a. m., and six o'clock p. m., of said day, and that the taking of the same will be adjourned from day to day, between the same hours, until they are completed.

CHA'S B. COLLIER,
Attorney for Def't.

(Upon the back of said notice is endorsed the words and figures following, to wit:)

PHILADELPHIA, *January 11th*, 1867.

A copy of the within notice is served on me this date, but this
307 admission waives no objections to the within testimony, or to the taking or using of the same.

HENRY BALDWIN, JR.,
Of Counsel for Complainant.

Deposition of William Wade.

WILLIAM WADE, a witness on behalf of the respondent, being first duly sworn to testify the truth, the whole truth, and nothing but the truth, testified as follows:

Questions by respondent's counsel, Tho's T. Heath:

Ques. 1. Please state your name, age, and place of residence.

Ans. William Wade; I am seventy-seven years old; I reside in Allegheny City, Pennsylvania.

Ques. 2. State what experience you have had, if any, in the manufacture and working of iron in its various branches.

Ans. My acquaintance with the manufacture of iron commenced in the year 1813, at which time I was a lieutenant in the Ordnance Department of the Army of the United States, and it became my duty
308 to attend at the foundries and witness the casting of iron cannon balls and shells, and to inspect the same when they were finished. In the following year (1814) it became my duty to witness the
309 casting of cannon, and to prove and inspect the same when finished. I continued in the service of the Ordnance Department about twenty years. I was promoted to the rank of major in 1825, and in 1832 I resigned. During the whole of that period I attended at the various foundries and arsenals, where it was my duty to superintend the casting and make proof and inspection, when finished, of all cannon. shot, shell, and munitions for the Ordnance Department. After I resigned, in 1832, I became part owner and active manager of a foundry in Pittsburgh, Pennsylvania. In this foundry we made steam engines, and cast heavy machinery of all descriptions. We were also engaged in casting cannon for the United States service of all the various patterns then used in the service. About the year 1834 we equipped the Pennsylvania Portage Railroad, and at our foundry we cast chilled cast-iron car wheels for the road, which were the first of that character made west of the Alleghany Mountains, and were made from drawings and patterns obtained by me from the Baltimore and Ohio Railroad, which I visited and carefully examined for that purpose. At this time, while casting cannon, my attention was attracted to the contraction of various kinds of iron, and I devised the contrivances for testing its strength, which I afterwards greatly improved, and which, together with notes of various experiments made by me, I fully set forth in my reports to the Ordnance Department of the United States, which were officially published as part of the public documents of the United States, to which I refer. I continued in charge of this foundry until the year 1840, when I was appointed by the United States Government as one of a board of officers to visit Europe to examine the foundries, arsenals, and armories in England, Scotland, France, Sweden, Russia, and Prussia. The board spent about ten months in examining these places. On the return of the board from Europe, I was appointed to attend and superintend the casting of all the cannon made for the United States Gov-
310 ernment at the various foundries, and it was my duty to ascertain the quality and characteristics of all the irons used, and to note the same, and the various processes of manufacture used. In the performance of this duty, in order to determine the quality and strengh of the iron used, and the effect produced upon it by the processes of manufacture, I devised various instruments for these purposes, which gave the most satisfactory results. I was occupied for ten years in the studies necessary for the perfection of these instruments,

and by them very satisfactorily tested the transverse and torsial strengths, and its density, both comparative and absolute, and resistance to crushing. This apparatus was adopted, and is now in use by the Ordnance Department of the United States, and the British Government gave an order for one of them, and afterwards procured fifty copies of the official reports made by me to the Ordnance Department of the United States, which order was duly filled. I continued in this service until 1852, when I resigned, and again reëmbarked in a private foundry business, when I became the principal manager, and manufactured all kinds of heavy machinery and castings, including ordnance for the United States. I continued in this until 1858, when the foundry was destroyed by fire; after which I was not engaged in active business, but occupied my time in studies in my library until the breaking out of the late war of the rebellion. Early in 1861 I was, for the third time, called into service by the United States, at Washington, where I remained till 1864, when, after more than fifty years study of iron and its manufacture, I resigned and retired to private life. The foundry alluded to as the one which I superintended prior to the year 1840, was the same known as the Fort Pitt Iron Works.

Ques. 3. Please state what knowledge you have relative to the annealing of iron castings prior to the year 1847, and particularly with the annealing of iron castings alleged to have been practised at the city of Pittsburgh, in the State of Pennsylvania, in which you were part owner, between the years A. D. 1831, and A. D. 1839; if iron castings
311 were annealed at said foundry, during the interval stated, you will please describe the various processes to which they were subjected, and the kinds of castings subjected to such processes?

Ans. I have knowledge of the annealing of iron castings prior to the year 1847. The idea of annealing cast-iron cannon by retarding the cooling of the casting, was first suggested to my mind in 1818, by reading Count Rumford's account of his experiments in artillery, which is contained in a volume of his Philosophical Papers, printed in London, in 1802, wherein, at page 210, he says: "The strength or toughness of cast iron depends much on the slowness with which it cools in the mould." And on pages 211 and 212 he says, in reference to casting iron guns for his experiments: "Means were used for prolonging the time of the cooling the metal in the mould." A board of artillery and ordnance officers was assembled in Washington, in 1810, of which I was a member. The remarks of Count Rumford attracted the attention of the board, and induced it to order the casting of a six-pounder iron cannon to be cooled slowly by means of a fire made within the gun-pit, which contained the mould at the time of casting. The gun was cast and cooled, accordingly, at General Mason's foundry, in Georgetown, sometime between September 1818, and August 1819. I was present at the time, and witnessed the same. I assisted at the proof of the gun, and it gave satisfactory results. The official report made by the board of officers to the Secretary of War, dated August 1st, 1819, referred to the experiments of Count Rumford, and expressed the opinion that "iron guns, for field artillery, may be made perfectly safe if care is taken to prevent the metal cooling too soon in the mould." In 1831 I became interested as one of the owners of an iron foundry in Pittsburgh, and was engaged in conducting its operations until 1839. During that period, it was a common practice to anneal iron castings in a reverberatory furnace. One of the methods practised, was to place the castings, while red hot, on the furnace hearth, as soon as practicable after the melted iron
312 was discharged from it, and then to cover them with dry sand

or cinders, or keep them covered closely until the following day. The furnace then in use for melting, and in which we practised annealing, was a wind furnace—cupola not then being in use. Another method was to embed the castings in the sand beneath the hearth before lighting the furnace fire, and to keep them in this position, where they would be heated by the flame and the melted iron in the furnace, and where they would remain until they were very slowly cooled. These methods of annealing iron were practised in order to soften it.

Ques. 4. Please describe minutely the process used in annealing the gun cast and annealed at General Mason's foundry, at Georgetown, D. C., in the year A. D. 1818, or A. D. 1819.

Ans. I was present, and saw that gun cast and annealed. The gun pit used by Gen. Mason was not in earth, but was blasted from solid rock. Consequently, its interior surface was somewhat irregular in its outline, and the pit was of greater dimensions than necessary for the casting. Gen. Mason provided a sheet-iron cylinder some eighteen or twenty inches greater in diameter than the gun mould, and about as long as the gun mould. After the gun was cast in the ordinary method, this cylinder was placed within the pit and around the gun mould, and the interval between its wall and the gun mould, being some nine or ten inches, was filled with charcoal on every side of the gun mould to the top of the cylinder and the gun mould. The first charcoal placed within this cylinder, and at the bottom of it, was ignited by the application of fire by one of the workmen, after which the cylinder was filled with charcoal, and the whole mass became ignited slowly, the mouth or top of the cylinder being open and exposed to the air. The combustion was not rapid, there being no regular draft; the whole mass was left in this condition until the charcoal was consumed, and the whole cooled
313 by radiation. This gun was a six-pounder field gun, and required between two and three days to cool it. In a casting of this kind in a large gun pit, which gives the air free access to the casting, it would cool very much sooner than this, if not retarded by the cylinder and charcoal.

Ques. 5. Please state whether you have read, and, if so, whether you understand, letters-patent issued to Asa Whitney, April 25th, 1848, for improvements in annealing and cooling cast-iron car wheels, an agreed true copy of which letters, now shown you, is hereto attached, named "Exhibit A."

Ans. I have read the letters-patent alluded to in the question, and think I understand the same.

Ques. 6. Please state wherein the processes of annealing, or either of them, as practised at your foundry at Pittsburgh, A. D. 1831, to A. D. 1839, and as practised upon the cannon at Gen. Mason's foundry, A. D. 1818–'19, are alike or unlike the process of annealing described in the letters-patent of Mr. Whitney in principle and mode of operation.

Ans. In my opinion the process practised by me at my foundry in Pittsburgh, between 1831 and 1839, in principle and mode of operation, was essentially the same as that described in the specifications and letters-patent of Mr. Whitney. The same philosophical principles were involved and the same effects produced by the two processes. In my process the castings were placed on the hearth of the furnace in which the metal had been melted, and raised to a very high degree of heat, after fusion, so that the hearth and walls of the furnace were of about equal heat to iron at its fusing point, when these castings to be annealed were placed within it. They immediately acquired heat, and were raised in temperature; they were covered over with hot sand so as to exclude

the air, and the whole mass raised to a still higher temperature by the heat which the hearth and walls gave off until equilibrium was produced, when the furnace, sand, and castings were cooled slowly and evenly by radiation. The castings being perfectly covered by the sand, a
314 good non-conductor, were in a confined atmosphere, and cooled as nearly simultaneously as practicable for castings to cool. It is impossible to cool a casting in every part at the same time. To illustrate: A heavy bar of iron, subjected to high heat, receives compact of heat on the surface, and an appreciable portion of time is occupied in transmitting the heat to the interior portions. A mass of molten metal, exposed to the air, will first give off the greatest heat from the particles on the surface, and an appreciably longer time will be consumed by the interior particles giving off their heat. A piece of cast iron, heated nearly to the melting point, suddenly thrust into a vessel of cold water, will give off the heat of the crust on the surface in an instant of time, so that the thin crust on the surface will be of the same temperature for the instant as the water, equilibrium existing between them; while the interior particles of the iron will yet be of a very high temperature, having parted with but little of their heat by conduction. The effects produced by me on the castings annealed by this process were gradual increase of temperature and as gradual cooling of the castings in the confined atmosphere as is practicable. In the process used in annealing the cannon at Gen. Mason's foundry, the principles involved and the mode of operation were identical with the process described in the letters-patent of Mr. Whitney, save that the casting was not raised in temperature. The slow combustion of the charcoal, acting upon the gun mould, raised the mould to a cherry-red heat, it being impracticable to heat the mould to a greater degree lest it should fuse or become ruptured, and permit the mass of molten metal it contained to flow out, thus destroying the casting. In my opinion, based upon my study, experience, and interchange of opinions with the most skilled iron founders, the effect produced by reheating castings taken from the mould while red hot, and slowly cooled or annealed, is to increase their bulk, diminish their specific gravity, and, as a consequence, make the iron
315 weaker. I arrived at this conclusion after many experiments, made through years of study on the subject, and, so far as I am acquainted, this is an acknowledged law among scientific and practical men. I remember, when I first made known this conclusion I had arrived at, to the late Cyrus Alger, of Boston, Massachusetts, then at the head of his profession, and the most accomplished iron founder I ever met in the United States or Europe, that he was not prepared to accept it; but that, after very careful experiment and study, he fully coincided in the opinion I had expressed, and conceded this to be a law, slowly cooling the casting from the point of congelation would not so perfectly relieve it from inherent strain, but would leave the metal itself stronger. The principles involved in the two processes are the same, differing in degree of application, and consequently in degree of effect produced.

Ques. 7. Please state what effect would, in your opinion, be produced on the chill of a cast-iron car wheel, heated to a point "say a little below that at which fusion commences."

Ans. It would leave the iron composing the chill in nearly the same condition it would have been had it not been chilled; the chill would be wholly or very nearly destroyed, so as to render it altogether worthless for the purpose of a chill.

Ques. 8. Please state to what degree you would raise the wheels in practising the process of annealing or cooling described in the letters-

patent of Mr. Whitney, if you were guided solely by the description and directions contained in said letters-patent.

Ans. "A point a little below fusion" is rather indefinite. Assuming Daniell, who gives about 2,786 degrees Fahrenheit as being the fusing point of cast iron, I would raise the wheels, by the direction of Mr. Whitney's letters-patent, to about 2,600 degrees Fahrenheit; and I may add that raising them to this point would be 1,200 or 1,500 degrees more heat than would be necessary to destroy the chill. I have no doubt at all that 1,500 degrees of Fahrenheit would destroy the chill in a cast-iron car wheel.

316 Ques. 9. Please state whether you have read the letters-patent granted to Albert L. Mowry, on the 7th day of May, 1861, for improved method of annealing car wheels, and whether you understand the same, an agreed true copy of which is annexed hereto, marked "Exhibit B."

Ans. I have read the letters-patent alluded to in the question, and I understand the process therein described.

Ques. 10. Please state whether or not the process described in the letters-patent of Mr. Whitney differs in principle, mode of operation, and effect produced, from the process described in the letters-patent of Mr. Mowry; and if your answer be that there be a difference, please describe the same fully.

Ans. The two methods are similar up to the time when the castings are removed from the mould to the annealing pit or chamber; after which the processes are materially different. By the method of Mr. Whitney the castings are placed in a heated pit, and the temperature is afterwards raised up nearly to the melting point; then the pit is so closed as to prevent the admission of air, and the castings are left to cool down very slowly. By the method of Mr. Mowry the castings are placed in a cold pit, and the temperature of the castings is not thereafter increased, but are permitted to cool down more rapidly. The equal cooling of the casting is promoted by a current of cold air passing through the centre of the hub, which accelerates the cooling of that massive part. The cooling of the rim, which is a thick part, is hastened by its near contiguity to the cold wall of masonry which forms the pit. The cooling of the intermediate part between the hub and the rim, which consists of thinner plate or disc, is retarded by the ignited charcoal which is placed upon it. If these means of hastening and retarding the cooling of the several parts of the casting are duly proportioned to the varying masses of metal to be cooled in each part, all of the parts will cool down simultaneously, so that the temperature in each and all the parts of the casting will be equal in all the stages of its progressive cooling.

317 The effect on the quality of the casting caused by Mr. Whitney's method will be, that the high temperature to which the casting is raised (assumed to be about 2,600 degrees, the melting point being 2,786 degrees) will destroy the hardness of the chill, will increase the bulk, and consequently diminish the density of the metal, and will lessen the strength of the casting. The inherent strains which are caused by unequal cooling of different parts of the same casting will be prevented by this method of annealing, but the strength and durable wear of the wheel will be thereby greatly diminished. By the method of Mr. Mowry the original depth and hardness of the chill caused by the iron part of the mould in which the wheel is cast will remain unimpaired, because the temperature of that part of the casting is not increased after it leaves the mould. All the parts of the casting being cooled equally, inherent

strains will be prevented, and the wheel will thereby retain all the strength and hardness due to the material of which it is composed.

Here adjourned until Friday, January 18, 1867, at 10 o'clock, A. M.

WILLIAM F. ROBB,
Notary Public.

FRIDAY, *January* 18, 1867.

Met pursuant to adjournment.

Ques. 12. Please examine the document now shown you, marked "Respondent's Exhibit C—Wade," annexed hereto, and if you know, state what the same is.

Ans. I have examined the exhibit referred to in the question, and I find it to be a copy of part of my "Report of Experiments on the strength and other properties of metals for cannon, etc., published by the authority of the Secretary of War, by Henry Carey Baird, in Philadelphia, 1856, beginning at page 184, and ending at page 201, of this public work, on the manufacture of 8 and 10-inch columbiads, officially made by me, on the 24th of January, 1852." This exhibit also
318 contains the final report made by me, published in the same public work, beginning at page 225, and ending at page 304, "On the strength and other properties of metals, used in the manufacture of bronze and iron cannon," which report was made by me in August, 1854.

Ques. 13. If you have made any experiments since your official reports were published by the Ordnance Department, for the purpose of ascertaining the effects produced on cast iron by hastening or retarding its cooling when cast, or by reheating and cooling it after it had been cooled, please state the particulars of such experiments.

Ans. I have made such experiments. In April, 1857, I cast five bars, each two inches in diameter and twelve inches long, in vertical dry sand moulds. One of them was cooled by taking it from its mould as soon as practicable after casting, and placed within a strong furnace blast of cold air, where it cooled very rapidly. Two of the bars remained in their moulds over night and cooled in the usual manner of foundry castings. One of the bars was cooled by placing its mould within another of much greater diameter, and by filling the interval between them with liquid iron when the bar was cast, and covering all with dry sand. The other bar was removed from its mould soon after casting, and placed at the bottom of a hollow core, within a large hydraulic cylinder, cast a few minutes previously, and enveloped with coal, where it remained until the core was cooled. Each bar was cast from iron in the same ladle, at the same time, to insure an equal quality of the iron in each of the bars. After casting, each of the bars was treated in the manner described in the following table. One sample was taken from each bar and tested, with the results therein stated.

319 Bars not annealed.	Density.	Tenacity.	
Cooled most rapidly	7, 229	33, 422	
Cooled in the moulds in the usual manner	7, 198	26, 793	27, 921
	7, 194	29, 050	
Cooling retarded as much as practicable	7, 112	19, 452	21, 698
	7, 050	23, 944	
Mean of all	7, 167	27, 680	

Three other samples were taken from each of the five bars, and sub-

jected to a reheating and cooling, in the manner described in a table which is herewith submitted. They were tested, and the results are set forth in the same table.

Reheated bars.	Mean density.		Loss of density.	Tenacity.	
	Before annealing.	After annealing.		Of bars.	Loss of strength.
Cooled rapidly	7.151	7.018	.133	24,736	2,940
Cooled very slow	7.166	6.789	.377	12,149	15,531
Cooled slow and decarbonized	7.183	6.945	.238	19,440	8,240

It thus appears that when cast iron is annealed by a gradual reheating and then cooled very suddenly, its density and strength, although somewhat reduced, is not very greatly impaired; but when the reheated bars are cooled very slowly, they lose more than one-half their strength. The loss of strength, as stated in the table is obtained by comparing the mean strength of each class of annealed bars with the mean strength of the unannealed bars. By comparing the quickly-cooled unannealed bar with the slowly-cooled annealed bars, the results are:

In the former	density,	7,229.	Tenacity,	33,422
In the latter	"	6,789.	"	12,149
Loss from annealing	"	440.	"	21,273

320 The loss in density is equal to about 28 pounds in the cubic foot, and the loss in strength is more than three-fifths of the strength of the quickly-cooled unannealed bar.

The figures given under the heading "Tenacity," indicate the number of pounds required to break a bar one inch square when strained in the direction of its length.

The experiments described in this answer were all made with great care; and the results were obtained and recorded with much attention to exactness, which, I believe, may be received as indicating the law which governs in the operations described.

Here adjourned until Saturday, January 19, 1867, at ten o'clock, a. m.

WILLIAM F. ROBB,
Notary Public.

SATURDAY, *January*, 19, 1867.

Met pursuant to adjournment.

Ques. Please state, if you know, when, in the history of the art of annealing, it first became known that reheating in annealing process would destroy the chill in castings.

Ans. It first became known to me, that reheating and annealing cast iron would destroy or impair the chill, about the year 1849, and I am not aware that it was known to others before that time; I am not able to state the exact date. It first became known to me that the slow cooling of iron, when cast, would impair its strength, in the year, 1845, when experiments then made by myself demonstrated it.

W. WADE.

321 *Deposition of Joseph Kaye.*

JOSEPH KAYE, being by me first solemnly sworn to testify to the truth, the whole truth, and nothing but the truth, testified as follows:

Questions by Tho's T. Heath, of respondent's counsel:

Ques. 1. Please state your name, age, residence, and occupation.

Ans Joseph Kaye; age 52; Pittsburgh, Pa. My occupation is foreman of the Fort Pitt foundry.

Ques. 2. Please state what have been your opportunities and facilities for becoming practically and theoretically acquainted with iron and the various processes of its manufacture.

Ans. In 1824 I began as an apprentice to the moulding business, and served a term of five years, after that I worked as journeyman moulder until 1842, in Pittsburgh, Pa. I then became foreman of the Fort Pitt foundry, where I have been ever since. I have read what books there are treating of iron and its manufacture, have held regular intercourse and exchanged opinions with the most practical and scientific men in the United States and Europe; and, since 1842, I have been a master, and have used all the various processes known in the manufacture of all kinds of castings, both heavy and light, including both land and naval ordnance, of all the various patterns in use in the last thirty-five years. I have manufactured the machinery for and equipped railroads, gunboats, steamboats, iron mills, glass manufactories, other mills, and, in brief, I believe I have manufactured whatever is made out of cast iron. I have very carefully studied and performed many experiments of various kinds, to determine the nature and properties of the various kinds of iron, their absolute and comparative strengths, and the effects produced upon iron by the various processes of manu-
322 facture. I have frequently been applied to for information by scientific and practical men throughout the United States, and also by commissions from the various governments in Europe.

Ques. 3. Please state whether you have read and understand the contents of the letters-patent granted to Asa Whitney, on the 25th of April, A. D. 1848, an agreed true copy of which is now shown you attached hereto, marked "Complainant's Exhibit A."

Ans. I have read and examined the letters-patent of Mr. Whitney, shown me, and understand the contents. I have had the same patent before, and have manufactured hundreds of car wheels by the process described in it, I think about the year 1849.

Ques. 4. Please state whether you are familiar with any process for the annealing or slow cooling of any castings in use prior to the year A. D. 1847, and if your answer be yea, please describe said processes fully, the kinds of castings annealed and cooled, when and where?

Ans. I am acquainted with various processes for annealing or slow cooling of iron castings, in use prior to the year 1847. In the year 1828, I annealed parts of cotton machinery, composed of blank and cog-wheels, bars, &c., by placing them in a cold state in a square cast-iron box, lined with brick, with charcoal inside the box and surrounding the castings to be annealed, and over this placed a coat of clay, perfectly luting the box, and then built a fire on the outside of the box, around and above it, and raised the box to a red heat, when the same was permitted to cool gradually, which occupied about one day. The largest wheels I annealed by this process were about eighteen inches in diameter. The pieces annealed in this manner when taken out of the box, were found to be soft, capable of being filed, chipped, and some of them

drawn out with a hammer. Before being placed in the box, the same pieces were white, hard, and brittle, exhibiting the properties, in a high degree, of chilled cast iron, but were not purposely cast on a chill.

323 As long ago as 1837, I cooled cog wheels two feet in diameter, pulleys and other castings, by taking them red hot from the moulds in which they were cast, and immediately placing them in the ash pit of the furnace, and raking down a large quantity of red hot coals upon them, completely covering them, and permitted them to remain there until the whole cooled by radiation, which occupied about one day. This was a common practice in Pittsburgh at that time. In the year 1847, I cooled an oil receiver, of cylindrical shape, weighing about 3,500 pounds, by taking the same from the mould in which cast, placing it on a carriage, and running it into a core oven, previously heated as high as the casting, with the oven containing fuel; when the doors of the oven were closed, and all draft shut off, and the whole mass left to cool by radiation, which occupied between 36 and 40 hours. In this same core oven, about the same time, I cooled wheels which were too large to be placed in the ash pit of the furnace, and weighing six or seven hundred pounds by taking them from the moulds, while red hot, placing them in a hot oven supplied with fuel, closing the oven and shutting off all draft, and allowing the whole to cool by radiation, which required between 36 and 40 hours. I practised this process at our works in Pittsburgh.

Ques. 5. Please explain the meaning of the term "anneal," or "annealing," as understood and used by practical founders.

Ans. The term "anneal," is very frequently used to indicate a process of cooling of almost any kind. Strictly speaking, to anneal a casting is to reheat the casting gradually, and then permit the same to cool gradually, by this means making the iron homogeneous, increasing it slightly in bulk, making it softer, diminishing its specific gravity, and making it consequently weaker. A process of slow cooling, in which the casting is not reheated, and the iron in which is not made homogeneous, nor its specific gravity reduced, nor the iron made soft, is not, correctly speaking, annealing, but slow cooling.

324 Ques. 6. Please state what differences there are between the process practised by you in 1847 in annealing the large oil receiver, and the large wheel in the core oven, as you have described the same, and the process described by Mr. Whitney for annealing or cooling cast-iron car wheels in his letters-patent. Please describe the difference in principle, mode of operation, and effect produced, between the two processes.

Ans. In principle, mode of operation, and effect produced, I do not conceive that there exists any difference between the two processes. Both processes take the wheel red hot, place it in a previously-heated oven, raise the temperature of the wheels in the oven, exclude the air and allow the whole to cool gradually, producing the effect of permitting the wheels to cool without inherent strains; both soften the metal. Both diminish the specific gravity, and both make the metal weaker. There was some difference in the shape of the ovens, but this could make no difference in the mode of operation, or effect produced.

Ques. 7. Please state what, in your opinion, would be the effect produced upon the chill of a cast-iron car wheel, if the wheel were raised to a degree of heat, say "a little below that at which fusion takes place," and the same was then allowed to cool gradually in the space of three or four days.

Ans. Unquestionably, the properties of the chill, treated in such a

manner, would be wholly destroyed, which I know from various experiments made by me to determine the matter.

Ques. 8. Please state any experiments you have made to test the effect of heat upon the chill of car wheels; describe the same fully, and give the results of your experiments.

Ans. In the year 1849, I think it was, Mr. Totten, one of the proprietors of our works, obtained from Mr. Asa Whitney, license to manufacture cast-iron car wheels by his patented process. I was at that time furnished with a copy of the letters-patent of Mr. Whitney, with
325 drawings and patterns for the ovens and wheels furnished by Mr. Whitney, and strictly in accordance with these I manufactured an hundred wheels for the Pittsburgh and Cleveland Railroad, which were shipped to Ravenna, Ohio, some four months afterwards; these wheels were condemned by the president of the road for being soft in the chill. We had a lot of wheels in the yard, of the same kind, made at the same time, of the same iron, and in the same manner. The president of the railroad, Mr. Prentice, with Charles Knap, one of the proprietors of our works, came to me and informed me of the chills being soft. I thought this could not be, as I had broken one every day, while we made them, to see the chill, which always appeared to the eye to be good. I immediately took these gentlemen to the yard, and caused one of the wheels, taken from the stock promiscuously, to be broken, which had the appearance of a good chill so far as could be detected by the eye; after reflecting and conversing on the subject, it occurred to my mind that the heat applied in annealing the wheels might have had some effect on the chill, when I at once procured a file, and was surprised to find that the file readily cut the chill on the wheel. We broke four new wheels at the time, in all of which the chills presented a good appearance to the eye, but were all readily cut by the file. I also, at the same time, took a chisel and chipped easily the chills right on the face of the tread. We at the same time tried the stock of wheels in the yard, and found all of them could be readily cut by the file, or chipped with the chisel, some of them being a little harder than others. Afterward I made a peep-hole so that I could see into the furnace, which I heated only to a very dull red heat, then placed the wheels in the furnace, shut the damper, and allowed the wheels to cool slowly, which modification and contrivance improved the quality of the chill, with now and then a cracked wheel at the top of the pile in the furnace. We made about 2,000 wheels by this process, when, finding it impos-
326 sible to produce a good wheel with the chill unimpaired, we abandoned the manufacture by this process. A few days after the experiments made with Mr. Prentice and Mr. Knap, I attracted the attention of Major William Wade to the case of the chills being destroyed in the wheels, and with him retested them by cutting with a file and chipping with a chisel, and together we sought to ascertain the cause of the destruction of the chill. To this time, so far as I am informed, scientific and practical men were ignorant of the fact, that a heat less than fusion would destroy a chill in cast iron. My attention had not been attracted to that before, nor have I ever met with any one who was acquainted with the fact prior to that time. I at once began experimenting, and witnessed a series of experiments planned by Maj. William Wade, with a view to test the effects of heating and cooling cast iron in various ways, with special reference to their strength, hardness, and density of the metal, which experiments clearly demonstrated that the hard chilled character of cast iron would be removed by heat, less than fusion, not greater than a bright red heat, since which time I have

a thousand times demonstrated the same fact in my daily business in various ways.

Ques. 9. Please explain what was your object in placing the peep-hole in the furnace of Mr. Whitney, at the time you were using his process, as stated in your last answer?

Ans. In using the quantity of coal directed in the patent of Mr. Whitney I found that, in practice, it frequently produced so much heat that the bottom wheel of the pile in the furnace was fused, the patent provided no means whereby this fact could be detected until after the furnace was emptied. I adopted the peep-hole to enable me to look in and see the quantity of heat being produced, that I might provide against their destruction by being fused.

Ques. 10. Please state whether or not you have read and understand the contents of the letters-patent granted to Albert L. Mowry, on
327 the 7th day of May, A. D. 1851, an agreed true copy of which is now shown you, and annexed hereto, marked "Exhibit B."

Ans. I have read and examined the letters-patent of Mr. Mowry, and I think I understand the contents of the same.

Ques. 11. Please state what difference, in your opinion, exists, if any, between the process described in the letters-patent of Mr. Whitney, and the process described in the patent of Mr. Mowry, in their principle, their mode of operation, and the effect produced?

Ans. In my opinion, the processes are very different, both in the principles involved and their mode of operation, and the effect produced. Both processes, in one respect, produce the same effect, namely: both prevent the wheel from rupturing in cooling. In doing so, the Whitney process makes all parts of the wheel soft, diminishes the specific gravity of the iron to a greater degree, and of course weakens it. The Mowry process does not increase the heat of the wheel, does not diminish the specific gravity of the iron, does not soften the wheel in every part, does not impair the chill, but rather improves it, by permitting it to cool gradually, and more rapidly than the plate; the tread and flange being nearer to the cold walls of the pit which absorb the heat very rapidly, are cooled faster than the other parts, thereby perfecting the chill, which was first created by the same principle of more rapid cooling. In the Mowry process, unlike the Whitney process, the current of air accelerates the cooling of the hub, which, if caused, even in the smallest degree, will be beneficial in relieving it from inherent strain and retaining the strength of the iron. The Whitney process is nearly allied in principle to that used in cooling heavy ordnance by us some years ago. We then attempted to secure all the heat in the gun pit, and retain the same for the longest possible time, it having no other way of escape than through the earth. A gun of ten tons weight, cooled in this way, in the space of ten days, would be ruptured after being fired, with the ordinary service charge, between two and three
328 hundred times. The Mowry process is analogous to that now used by us in manufacturing ordnance, wherein we pass a current of cold air or cold water, through the bore of the gun, accelerating the cooling of the central portion, and retarding the cooling of the outside, so that all parts, in the end, may be cooled simultaneously and alike. By this process, we cool a gun of ten tons weight in four days, which will bear the strain imposed by firing from 1,000 to 1,500 rounds with the ordinary service charge.

JOSEPH KAYE.

Deposition of Edward S. Wayne.

EDWARD S. WAYNE, being first duly sworn, deposeth and saith:

Ques. 1. Please state your name, age, residence and occupation?

Ans. Edward S. Wayne; residence Cincinnati; am a chemist, and am 48 years of age.

Ques. 2. State what have been your opportunities and facilities for an acquaintance with the useful arts, both practically and theoretically, and the inventions and improvements therein. And if you have been familiar with any of the branches of iron manufacture, please state that also.

Ans. I am familiar generally with the manufacture of iron in all its branches; the improvements that have been instituted in the manufacture of it, and am generally acquainted with all the useful arts, both practically and theoretically. For more than thirty years I have been practically investigating and concerned in scientific pursuits connected with the useful and mechanical arts, and have been frequently called upon to testify as a scientific expert in the trial of patent cases in the United States courts.

329 Ques. 3. Have you read and do you understand the contents of an agreed true copy of letters-patent, numbered 1248, granted to Albert L. Mowry, by the United States of America, on the 7th day of May, 1851?

Ans. I have read and understand the same.

Ques. 4. What invention, process, or improvement do you find described in that patent?

Adjourned until Wednesday, December 26, 1866.

WEDNESDAY, *December* 26, 1866.

Ans. I find the patent describes a method, or process of annealing car wheels made of cast iron. The wheels after being removed from the flask, as soon as they are cool enough to be handled without danger of breaking, they are then placed in an annealing pit, so arranged that a draft or current of air may pass through it. Previously to placing in the first wheel, a quantity of charcoal is first placed in the pit, the yet hot wheel is then lowered into the pit on to the charcoal. More charcoal is then placed upon the top of the wheel that has been placed there, and then another hot wheel placed upon it, and so on till the pit is full. The pit is then enclosed with a cover, and a damper through the top of it opened to admit air to support the combustion. The wheels then are left for a space of seventy-two hours, by which time the charcoal, by slow combustion, has been more or less consumed, and the wheels gradually cooled down, so that they may be removed from the pit without injury.

Ques. 5. Have you read and do you understand the contents of an agreed true copy of letters-patent, granted to Asa Whitney, by the United States of America, April 25, 1848, numbered 5531?

Ans. I have read and do understand the contents of those letters-patent.

330 Ques. 6. After comparison of the two patents, and judging from the contents thereof, please state what, in your opinion, is the object sought to be obtained by the patentees, Mowry and Whitney, respectively.

Ans. The object sought by both patentees is the cooling or annealing the wheels in a slow and gradual manner, so no inherent strain, defect, or fracture may occur.

Ques. 7. Please state in what respects the process described in the patent of Mr. Mowry is alike or dissimiliar to the process described in the letters-patent of Mr. Whitney, in the method and means employed to accomplish such object?

Ans. In my opinion, the two processes differ widely and for the following reasons: In Whitney's patent, the wheels are taken from the flask or mould as hot as possible, then placed in a furnace or oven that has been previously heated, and an arrangement made, whereby the heat may be kept up by a furnace, or otherwise, and the wheels then and there heated to a much higher point than they were when placed there. Whitney mentions that the point necessary for them to be raised to for the accomplishment of his patent or process is that of incipient fusion. In Mowry's process or patent, the wheel is taken from the mould as hot as possible, placed in a cold pit, surrounded more or less with charcoal on the top of the plates, and when the pit is full, covered, and a slight draft formed through the mass, or through the eye of the wheel. The ignition of the charcoal is caused by the heat in the wheel, when placed there. It is sufficiently hot to ignite it. A slight smouldering combustion is thus formed, and is not, in my opinion, great enough to cause the generation of any amount of heat superior to that of the wheels when placed in the pit. I think that the wheels cool gradually from the time the wheels are placed in the pit until they are taken out. The combustion of the charcoal merely retarding the cooling to a certain extent.

Ques. 8. Please compare Whitney's process as described in his letters-patent, with the processes described in Exhibits Nos. 1, 3, 4, 6,
331 and 7, for annealing glass, etc., and describe what, in your opinion, are the points of similarity or difference between the same?

Ans. I can see no difference in them at all. I regard the processes as identical. In both cases of glass and iron the only object of heating them and cooling them slowly, is to give the material time to arrange itself in such a manner that no undue strain or fracture may occur.

Ques. 9. Please compare the process described in the letters-patent of Mr. Whitney, with the process described in the depositions of George G. Lobdell and Lysander A. Orcutt, taken in this case, agreed true copies of which have been furnished you, and describe whether, in your opinion, the same are alike or dissimilar.

Ans. I consider Whitney's process as different from either. In Whitney's process the wheel is heated to a higher point than in either of those mentioned. I consider annealing, no matter how done, identical in a degree, and for the same object, allowing the material to cool slowly, so that it may arrange itself so as to produce no undue strain or fracture, equally applicable to glass as well as iron.

Ques. 10. Please state, in reference to your last answer, whether the difference, in your opinion, existing between the processes compared is a difference in kind of effect produced, or in degree of effect produced. Explain this fully.

Ans. The Whitney process is not similar to either of them. In the Whitney process, the wheels are reheated after being taken from the mould, and allowed to cool. In the process described by Orcutt, the wheel, after being taken from the mould and placed in the core oven, is not reheated; the temperature of the core oven being less than that of the casting. It merely is allowed slowly to cool there. In Lobdell's process there are slight approximations to the process of Whitney; the casting being covered over, the contents of the cupola may cause, to a certain extent, a reheating of the wheel. This, however, will de-

332 pend to a certain extent, upon the size of the casting and the amount of coal and cinder thrown upon it from the cupola.

Ques. 11. Please state, whether not, in your opinion, the same law governs in annealing, whether the article to be annealed be large or small.

Ans. The same.

Ques. 12. Please state what understanding you derive from the description contained in Mr. Whitney's letters-patent, as to the degree of heat to which the wheels should be raised in the process therein described.

Ans. Mr. Whitney mentions incipient fusion as the point they are to be heated to.

Ques. 13. What means, other than by experiment, are pointed out in the patent of Whitney for ascertaining when the wheels are at a heat "a little below that at which fusion commences?"

Ans. None, that I see.

Ques. 14. What would be the effect on the "chill," if the wheels were heated to a point "a little below that at which fusion commences?"

Ans. I am satisfied it would be destroyed. I am also satisfied that any reheating of the wheel in a pit or oven beyond the temperature at which it was when placed there, would result in injury to the chill.

Ques. 15. State whether or not you have made any experiments to ascertain the effect of heat upon chilled cast iron; and if so, describe the nature of such experiments, and the result obtained.

Ans. I have, and have found that a continued heat much below that of incipient fusion, continued even for ten or twelve hours, would perfectly destroy the chill.

Ques. 16. State what degree of heat you mean by a degree "much below that of incipient fusion." Give the difference in degrees.

333 Ans. The heat I applied was a bright red heat. I should think the temperature did not exceed 1,200 or 1,300 degrees Fahrenheit. Incipient fusion would be from twenty-five to twenty-seven hundred Fahrenheit.

Ques. 17. State whether or not the twelve or thirteen hundred degrees of heat, applied for ten or twelve hours, as stated in your last two answers producing absolute destruction of the chill, would, if applied for a less period of time, produce an effect different from that above stated.

Ans. I think it would. It would injure it in a degree.

Ques. 18. Please state what number of degrees Farenheit are represented by iron heated until it exhibits the color known as "cherry red."

Ans. Between ten and eleven hundred degrees Fahrenheit, I believe.

Ques. 19. What difference, if any, is there between the heat of iron at a cherry red," and iron heated to a point, "say a little below that at which fusion commences?" Please give the difference in degrees Fahrenheit.

Ans. I should think the difference would be at least from twelve to fifteen hundred degrees Fahrenheit.

Ques. 20. Please state whether or not, in Mowry's process, the effect of the charcoal would be alike on every part of the wheel in the annealing pit; and, if your answer be that the effect would not be alike in every part, explain what parts would be effected more, and what less.

Ans. I do not think the effect would be alike in every part of the wheel. My impression is that the incandescent coal would act as a storehouse of heat to the plates of the wheel. The hub and tire may be to a certain extent cooled by the draft through the pit, but at the same time,

I question very much whether any part of the wheel really cools any faster than the other. For instance, if the thin plates by exposure did cool more rapidly than the other, the heat of the thicker portions
334 would be rapidly conducted to the thin portions, and, to a certain extent, preserve the equilibrium and simultaneous cooling.

Ques. 21. Explain your last answer as to whether or not you mean that all parts of the wheel in the annealing pit are of the same degree of heat, and in every part cool together and at the same time; and, if you do not mean this, please describe in other terms what effect would, in your opinion, be produced.

Ans. I stated in my answer to the previous question, that the coal between the wheels acted as a storehoese of heat to the thinner portions of the wheel. The conduction of heat is transmitted to them in the same manner as mentioned of the heat existing in the thicker portions of the wheel. I am of the opinion that no one portion of any of the wheels in the pit is ever any hotter than the other. The combustion of the charcoal is merely a smouldering one. Such combustion can generate or yield no heat greater than that of the wheel when placed in the pit. The current of air admitted into the pit is so small that it will not support a rapid combustion, and has but a very little effect upon the temperature of any part of the mass. The cooling is more by radiation than by the current of air.

Ques. 22. Are the wheels when taken from the flasks, and at the instant they are placed in the annealing pit, in the process of Mr. Mowry, of the same degree of heat in every part; and, if your answer be nay, state which is the hottest.

Ans. I have seen a number of wheels taken from the flasks, and would give it as my opinion that they were of uniform temperature throughout.

Ques. 23. State whether or not, in your opinion, a heavy casting, one part of which was formed in a sand mould, and another part cast against an iron chill, would, on being removed from the flask as soon as sufficiently cooled to bear its own weight, be of the same degree of temperature in every part.

Ans. That would depend upon circumstances. It would de-
335 pend upon the size of the casting and the size of the chill, if the chill which the casting was moulded in was very thick, so as to conduct the heat off rapidly, it might be.

Ques. 24. Please explain the nature of a "chill" in iron, and the principles of its production?

Ans. A "chill" upon iron is caused by the rapid cooling of the melted metal. The extent of the chill depends upon circumstances. For instance, the more rapidly the surface is cooled in contact with another metal, say iron, the deeper the chill would be produced. All castings are chilled, to a certain extent, by the atmosphere. The condition of the iron composing the chill differs in composition from other parts of the same casting not subjected to the chill. Cast iron is composed of metallic iron and a certain per centage of carbon in different states of combination. The peculiar combinations of iron and carbon constitute marked varieties known in the arts and sciences, such as gray, mottled, and white cast iron. A "chill" approximates to what is known as white cast iron. It is harder and more brittle than the other varieties. The carbon in the chilled iron is in a state of chemical combination. In the others it exists more or less in a free state. Iron under the influence of heating and cooling may be made to assume either one or the other of the above conditions—that is, gray or mottled iron may, by

rapid cooling, be made to assume the character of white or chilled iron; it, on the other hand, assumes that of gray mottled iron. Their appearance or physical characteristics are also different. That of white or "chilled" iron is less *chrys*talline than the others. It is lamellar. The gray, or soft, iron has more *chrys*talline form.

Ques. 25. What is the degree of heat in a wheel at the instant it is taken from the flask?

Ans. I have seen a number taken from the flask, and should say, from observation, at a cherry-red heat—I should say from nine hundred to a thousand degrees.

336 Ques. 26. Examine the piece of iron now shown you, marked "Respondent's Exhibit number 9," and, if you know, state what it is.

Ans. It is a piece of cast iron with the chill upon it. It is a portion of iron taken from the cupola previous to casting the wheels to determine the extent the chill may be produced upon it. It is customary always to test the metal in this manner before casting it into wheels. The chill upon this specimen of iron was from half to five-eighths of an inch in depth, This piece of iron I placed in the crucible and submitted it to a bright-red heat in a furnace for about ten hours. It was allowed to remain in the same furnace, and allowed to gradually grow cool, which occupied about the same time. Upon testing it I find the chill is destroyed. The iron has become exceedingly soft, and may be cut with a file readily, chipped or hammered.

Ques. 27. How many degrees of heat was that piece of iron subjected to?

Ans. I give it as my opinion that the greatest amount of heat that piece of iron was subjected to was from 1,400 to 1,500 degrees, judging from the color. At no time was it subjected to a white heat, or a point approximating to incipient fusion. The sharpness of the angles not at all disturbed, nor has it oxydized to any great extent.

Ques. 28. Please examine the process described as being the process practised in Mr. Whitney's manufactory, as testified to by Henry Snyder, in answer to questions 4 and 5, and subsequently in his deposition given in this case, an agreed true copy of which is shown you; compare the same with the process as described in the letters-patent of Mr. Whitney, and, if there be any difference between the two, point it out, and give the difference in degrees.

Ans. There is a difference between the two. The specifications in Whitney's patent mention that after the wheels are placed in the
337 annealing chamber, to accomplish his purpose, they are to be heated up to a point a little below that of incipient fusion. The witness Snyder testifies that they only heat them in practice to a red heat. There is a wide difference in the temperature between a red heat a point a little below incipient fusion. I should say in degrees it would be from ten to twelve hundred degrees Fahrenheit.

Ques. 29. Please refer to question 23 and your answer thereto, and state whether or not you comprehended the question as you now do, and whether or not your answer before given is as you would give it in answer to the question as you now understand it; and if not, please answer the question as you now understand it.

Ans. As I have mentioned in my answer to question 23, I can but reiterate to a certain extent what I have already mentioned in answer 23, that the cooling of the casting—certain portions of the casting exposed to the chill—depends first on the magnitude of the article cast, and the thickness of the chill. The thicker the chill-mould was, I should say would be more rapid and complete the cooling of the metal ex-

posed to it. A very thin casting would be cooled almost immediately. The thicker the casting the slower the cooling. When taken from the flask I should think a heavy casting, if subjected to a chill, would be somewhat cooler than the balance of the wheel at the part subjected to the chill.

Ques. 30. State whether or not cast-iron car wheels, as used in the processes of both Whitney and Mowry, are not heavy castings, under the same conditions, and exhibiting the same result, as the one supposed in question 23.

Ans. They are.

Ques. 31. State whether or not in the process described in Mowry's letters-patent, the wheels at any time, while in the annealing pit, are raised in temperature to a degree greater than that at which they were when placed therein.

Ans. They are not, in my opinion. I should say they com-
338 menced cooling from the time they *are* placed in there until removed. The combustion of the charcoal placed along with the wheels is so slow that but little heat can be generated by it.

Cross-examined by complainant's counsel, S. S. Fisher, esq.:

Ques. 1. You have spoken in direct examination of various degrees of temperature. Please to state whether you have given these degrees, with confidence, as accurate determinations of the temperature of iron at the different stages named?

Ans. I have given them, not absolutely, but as approximations. They are mentioned in the various text-books.

Ques. 2. What is your opinion of the accuracy of such approximations?

Ans. I do not consider them absolutely reliable. There is a very great difficulty in taking such temperatures. I have never experimented myself. In mentioning the temperature "red heat," "white heat," "incipient fusion," etc., I have approximated the temperatures mentioned in the text-books, and generally recognized.

Ques. 3. Looking to the drawing illustrating Mr. Whitney's furnace, and considering the use of his apparatus in the second manner for which he provides, to wit, taking the requisite heat in a suitable conduit from the furnace in which the metal is melted to the annealing chamber, please to state how far it would be possible, in your opinion, to raise a pile of ten or twelve wheels to a point of incipient fusion by such process?

Ans. I should think they could be raised to a point of incipient fusion. The conditions almost amount to that of a reverberatory furnace, or wind furnace,

Ques. 4. What do you say of producing the same result by the use of one-fourth of a ton of coal distributed upon the grate bars surrounding a pit of a dozen wheels, without a blast?

Ans. To answer that question I would like to know what length of time the coal has been in consumption. I should say, from my
339 knowledge of anthracite coal, that it requires considerable draft for combustion; and, from the area of the grate-bar surface, that there would be sufficient heat generated there to approximate closely to the temperature mentioned in the patent.

Ques. 5. Suppose the conditions under which this coal is used, to be as follows: "The cover to the furnace, being movable, is raised when the wheels are put in, and is then closed and covered with earth, to prevent the too rapid escape of heat. The damper in the flue leading to the chimney is also closed after the wheels are put into the furnace, and

the opening in the lower wall stopped by an iron plate banked with earth, which prevents the escape of heat in that direction."

Ans. I should say this furnace with the top closed, covered with earth; the damper closed; the mouth of the pit covered with the plate; all avenues of draft cut off, there would be no combustion at all. The fire would be smothered out.

Ques. 6. Then the action of the heat upon the wheels would be only during the interval between their deposit in the pit, and the closing these avenues?

Ans. That would be all.

Ques. 7. Have you seen in any of the exhibits which have been shown to you, any process described besides those of Whitney and Mowry for the application of annealing or slow cooling, as a stage or step in the manufacture of cast-iron car wheels?

Ans. I have seen none.

Reëxamined by Thos. T. Heath, esq., of counsel for respondent:

Ques. 1. Please state whether or not the estimates you have given of the various degrees of heat, in answers to previous questions, have been as accurate, and approximate as closely to absolute truth, as the tables published in the text books on the subject?

Ans. I believe they are.

340 Ques. 2. Please point out what devices or means are described in Mr. Whitney's letters-patent, in the second manner therein alluded to, of annealing the wheels by admitting heat from the furnace through a conduit, whereby one practising the process, could determine what degree of heat was being permitted to operate upon the wheels in the annealing pit.

Ans. There is none.

Ques. 3. In cross-question 5, in addition to the conditions therein supposed, add this condition: "As soon as they (the wheels) are deposited in this furnace or chamber, the opening through which they have been passed is closed, and the temperature of the furnace or chamber and its contents, gradually raised to a point a little below that at which fusion commences, when all the avenues to and from the interior are closed, and the whole mass left to cool no faster than the heat it contains permeates through and radiates from the exterior surface of the materials of which it is composed," would in this case the amount of anthracite coal stated in the cross-question, produce the effect as in the case supposed in the cross-question; and if not, what would be the effect?

Ans. I am satisfied that that amount of coal with the grate-bar surface, is capable of producing the amount of heat mentioned in the patent, "A point a little below that at which fusion commences."

E. S. WAYNE.

Deposition of Richard Bromley.

RICHARD BROMLEY, being first solemnly sworn to testify the truth, the whole truth, and nothing but the truth, deposes and says:

Ques. 1. Please state your name, age, residence, and occupation.

Ans. My name is Richard Bromley; I am 45 years of age; re-
341 side in Hamilton County, Ohio, and am master of machinery of the Little Miama, Columbus and Xenia Railroad. My profession is that of a practical and theoretical machinist.

Ques. 2. Please state what experience you have had, and what opportunity for observation, as such theoretical and practical machinist.

Ans. I have been a machinist nearly 33 years; during the whole of this period I have been engaged in making iron, or iron machinery, or running the same, or superintending the running and making the same. From the first of March, 1856, I have had entire control of the locomotive car machine shops of the Little Miama Railway Company, at Cincinnati, Ohio. Previous to that time I had control of two machine shops at Norwalk, Ohio, for several years.

Ques. 3. State whether or not you have become conversant with the different methods of casting and annealing railroad car wheels.

Ans. I have been familiar with the manner of making and annealing car wheels since 1847 or 1848, and I know the different kinds in ordinary use, and know the different qualities of each and their peculiar characteristics.

Ques. 4. Have you read and do you understand the process of manufacturing car wheels, described and specified in a certified copy of letters-patent now shown you, numbered 5531, and granted to Asa Whitney, April 25th, 1848.

Ans. I have read the letters-patent and the specifications, and I understand the same and the process they describe, and have also witnessed the process as practised at the works of Mr. Whitney, in Philadelphia, and have had the process described to me by Mr. Whitney, at his works.

Ques. 5. Have you read and do you understand the letters-patent and the process described therein, granted to Albert L. Mowry, on the 7th day of May, 1861, numbered 1244, now shown you.

342 Ans. I have read the letters-patent, and I understand them and the process, and am thoroughly acquainted with the process as practised at the works in Cincinnati, having frequently witnessed the same.

Ques. 6. Understanding as you do the process patented and practised by Mr. Mowry, and also understanding the process patented and practised by Mr. Whitney, in the manufacture and annealing of cast-iron car wheels, please state whether or not the process of Mr. Mowry is included in the process of Mr. Whitney; and, if your answer be "nay," explain fully the points of difference in the idea, the mode of operation, and the effect produced by the processes respectively.

Ans. In my opinion there is a great difference between the two processes, both in the idea, in the effect produced, and in the manner in which it is produced. The distinguishing characteristic of Mr. Whitney's process is, that the furnace in which the wheels are deposited is previously heated to such a degree that the red-hot wheel, on being removed from the flask and deposited in it, immediately receives additional heat, and is raised in degree of temperature in every part of the wheel above that degree at which it was when taken from the mould. The furnace or pit is opened to receive each wheel, and in the intervals between the reception of wheels is carefully closed so as to prevent the escape of heat, and when the furnace has received its complement of wheels, every inlet and outlet of air is closed, and the whole mass allowed to cool by simple radiation, the fires in the furnace dying out from lack of supply of oxygen, and each wheel cooling alike in every part. In the process of Mr. Mowry, the furnace or annealing pit, is perfectly cold; the charcoal fuel used is distributed in layers between the plates of the wheels, and inside of the tread and flange, and between the hub, and produces its effect directly upon the thinnest part of the wheel—the plate. While the annealing pit is receiving its complement of wheels,

it is entirely open to the surrounding air until the pit is full, and
343 a current of cold air continually passes down through the eyes or hubs of the wheels, which contain more metal than the plate, and cool faster than the plate by the admission of this current of air. The tread and flange of the wheels, when first deposited, are reduced in temperature rapidly, by coming in contact with the cold brick lining of the pit, while the thin part of the wheels retains its original heat, and may be slightly raised in temperature by the combustion of the interlaid charcoal. When the pit is filled with wheels a cover is placed upon it, with a pipe containing a damper, through which the cold air continues to pass downward through the tube, at the discretion of the operator, admitting air fast enough to supply the combustion of the contained charcoal, and accelerate the cooling of the heavy parts of the wheels, and retard the cooling of the light or thin parts of the wheels, until at the end of three or four days they shall be cool alike. By the Mowry process the wheels at no time are in every part at the same temperature. They at no time are raised in every part to a temperature above that at which they were when taken from the moulds, nor do they in every part cool simultaneously and together, but during a part of the process the heavy parts cool the most rapidly. In Mr. Whitney's process, immediately the furnace is closed and luted, the fuel ceases to burn, from lack of oxygen. In Mr. Mowry's process the fire is not permitted to die out, but is sustained by a regulated admission of oxygen, until all the charcoal is consumed.

Ques. 7. Please state whether or not, under your control and direction, the Little Miami Railroad Company have used large numbers of railroad wheels, made and annealed by Mr. Whitney under his process, and also those made and annealed by Mr. Mowry under his process; and if so, state whether or not a different effect was produced by the two processes; and if so, state what you have observed that effect to be.

Ans. I have used large numbers of wheels made and annealed
344 by the two patentees, under their respective processes, and I have clearly observed a difference of effect produced upon the wheels. In the chill, and anneal, and wearing properties, the Whitney wheel is inferior to the Mowry wheel. This is the result of my observation and experience through several years' test and use of large numbers of wheels made by the Whitney and Mowry processes. In addition to testing these wheels by the ordinary wear and tear of use on the road, I have also tested the Whitney wheel with the Mowry wheel under the hammer. The wheels, the hammer, and the blows being the same, the Whitney wheels broke on the eleventh blow, the Mowry wheels broke on the seventeenth blow. After the fracture, the fragments of the Whitney wheels would not come together so as to make a close joint with all the parts, clearly showing that in cooling or annealing, the strain was greater on some parts than on other parts. In the Mowry wheels, in the same tests, all the parts came together, making close joints, and proving that the parts were relieved from irregular strain, and all the parts had been cooled alike. From this observation and these experiments on the Whitney wheel, I became convinced of its inferiority, and recommended the railway company not to use any more of the Whitney wheels, which recommendation was adopted by the company.

RICHARD BROMLEY.

345 *Deposition of William Clough.*

WILLIAM CLOUGH, being solemnly sworn to testify the truth, whole truth, and nothing but the truth, deposes and says:

Question 1. Please state your name, age, residence, and occupation.

Answer. Name is William Clough aged (45) years; and reside in Cincinnati; my occupation is consulting engineer and patent solicitor, in which business I have been engaged for the last ten years; previously to which time I was engaged as proprietor and manager of various manufactories, among them are extensive railroad car manufactories, in which business I used several thousand car wheels which were made under my direction.

Ques. 2. State whether or not you have frequently heretofore testified as scientific and mechanical expert in cases in the United States courts.

Ans. I have testified in many patent cases.

Ques. 3. State whether or not you have read and do you understand the process described in a certified copy of letters-patent granted to Asa Whitney, on April 25th, 1848, including that part of the whole process which he specifies and claims to be his invention?

Ans. I have read the specification referred to in the question, and think I understand it. I have also witnessed the operation of making and annealing wheels as practised by Mr. Whitney in his establishment in Philadelphia.

Ques. 4. State whether or not you have examined and understand letters-patent granted to Albert L. Mowry, of Cincinnati, Ohio, on May 17th, 1861, the originals of which *is* now shown you, and whether or not you have witnessed the process used by Mowry at his car works in Cincinnati, Ohio, and understand the same.

Ans. I have read the letters-patent referred to in the question, and understand the invention therein described. I have also witnessed
346 the process of making and annealing car wheels as practised by Mr. Mowry, at his establishment in Cincinnati, and understand the same fully.

Ques. 5. State whether or not the process as used by Mr Mowry at his car works in Cincinnati, is included in that used by Mr. Whitney in his works in Philadelphia, and is essentially the same in idea, in mode of operation, and in effect produced; and, if your answer be nay, state the difference in principle between the processes respectively.

(Objected to.)

Ans. By the Whitney process pits are provided with a furnace in connection therewith, by which the furnace is preheated to a high degree, as a preparatory step. The wheels are then removed from the moulds in which they are cast, and placed in the preheated pits; the pits are then closed and luted or otherwise made perfectly tight, and the temperature of the contained wheels thus receiving heat from the highly-heated walls of the pit, and the incandescent coal of the furnace, becomes raised to nearly the point of fusion, the wheels being heated in all their parts uniformly and to about the same temperature. They are then allowed to remain in this highly-heated pit until, by the absence of air, the combustion of coal in the furnace ceases, and the heat of the furnace, including the walls of the pit and also the contained wheels, slowly and uniformly subsides to a temperature at which the wheels can be safely removed. This process provides for raising the temperature of the wheels uniformly and in all their parts to a point a little below fusion, and then allowing the heat to slowly subside uniformly, and in all parts of the

wheel alike, thus producing an added temperature to the wheels sufficient as is supposed, to permit the metal of which they are composed, to readjust itself, and in its subsequent cooling to accommodate all parts to each other and relieve the wheels of all the dangerous strains imposed by the abrupt cooling in the operation of casting in a chill. By the Mowry process the wheels are taken from the moulds and placed, while still hot, in a cold pit, one above another, with a small layer about one-third
347 of a bushel of charcoal between each—the coal being carefully deposited in the annular space afforded between the hub and rim of the wheels so that the heat given out by the slow combustion of the coal is communicated to the plates or webs of the wheels respectively, between which the coal is placed, and not to the outer rim of the wheels nor the central hub. The wheels are so arranged in the pit that the eyes or apertures through the hub, coincide with each other, and together form a vertical flue from top to bottom. This flue opens into a horizontal flue leading from the bottom of the pit, and is prolonged upward from the top by a pipe in which is a valve for regulating a supply of air. Through this flue air is caused to circulate, passing through the eyes of the whole series of wheels, and causing those heavy parts of the wheels to be rapidly cooled; the air at the same time supports a slow and regulated combustion of the coal between the plates which prevents the temperature of these parts from being so rapidly cooled. At the same time the rims of the wheels being in close proximity to the cold walls of the pit, lose their heat rapidly by radiation, and receive no heat whatever in return, except that which is slowly communicated by convection from the plates, where the coal is sluggishly burning. The idea proceeded upon in Mowry's process is not that of raising the temperature of the whole, or any part of the wheel to a point which will permit of a readjusting of the metal, and a subsequent cooling of all parts uniformly and alike, thus relieving the wheel of strain as is provided in Whitney's process, but it consists in allowing the rim of the wheel to cool as rapidly as it will by proximity, and perhaps in some cases contact with the cold walls of the pit, and accelerating the cooling of the hub by a current of air passing through the eyes or apertures in them, while the temperature of the thin plates or webs which connect the rims and hubs, is maintained at a degree which will enable them to contract and expand sufficiently to accommodate the strain imposed by the rapid cooling of the other and heavier parts. I regard the process of Mr. Mowry
348 as essentially different in kind, mode of operation, and effect, from that employed by Mr. Whitney.

Ques. 6. Please state whether or not at the time the pit in the Mowry process is filled with wheels and closed, it can be considered in any degree a previously-heated pit or furnace?

Ans. Certainly not. The wheels upon being first put into the pit, give off their heat to the walls, and are reduced in temperature by all the heat which they communicate to the walls, and they cannot be said to receive any heat from the walls. The combustion of coal—the small amount which is placed between the plates of the wheels does not, in my opinion, suffice to compensate for the loss of heat by radiation from the rims of the wheels to the walls, so that the wheels, particularly the rims adjacent to the walls, lose heat and become reduced in temperature from the moment they are put into the pit, and continue to lose heat and become reduced in temperature from when they are put into the pit until removed. The hubs of the wheels are exposed to a current of air through their eyes, and of course lose heat continually and become reduced in temperature from the time they are admitted to the pit until removed.

I do not think the idea of preheating or reheating obtains to any extent whatever in the Mowry process.

Ques. 7. State whether or not you are acquainted with the tests known and usually applied in the art for proving the presence or absence of unequal strain in annealing castings of iron; if so, describe the best tests.

Ans. I am familiar with the tests applied by mechanics and engineers for determining the strength of wheels and other castings of iron, and particularly with modes of determining the presence of unequal strain in car wheels. The mode generally employed for testing car wheels is by a succession of uniform blows with a sledge, applied to the part which it is desired to test, or by dropping a weight from a given height upon the wheel. Wheels that are cooled with consid-
349 erable strain upon their parts, will frequently break under the first few blows, while those which have less unequal strain will resist the blows for a long time. The broken parts of a wheel which has been cooled so as to leave considerable local strain, will, upon being relieved from each other, change their form so that they cannot be replaced together forming tight joints, while the fragments of wheels in which the local strain has been taken off or obviated, will not change their form, but will come together forming close joints. No better test of the homogenity of the wheel than its coming together closely after being broken, can be found.

Ques. 8. Please examine Exhibits 1, 2, 3, 4, 5, and 6, now shown you, and state whether or not there is an analogy and identity between the processes therein described and the process described in the patent of Mr. Whitney; and if so, point it out.

Ans. I find the processes referred to in the exhibits are in many respects identical with the process described in Mr. Whitney's patent. They all contemplate, as he does, the removing of the brittleness of metal or glass by means of reheating or prolonging the time of cooling. They all provide for accomplishing this object by various means; but all on the same general principle—a principle which has been long known, and is familiar in the art.

In Exhibit 1, speaking of rendering cast iron malleable, it is said, "The metal is kept for several hours at a temperature a little below its fusing point, and then allowed to cool slowly."

In Exhibit 3, it is said, in speaking of the process of annealing glass, "To avoid this (the frangibility of glass) the process of annealing is resorted to, which is nothing more than cooling the heated or melted substance as slowly and equally as possible, often in a separate furnace of requisite heat, and sometimes called an annealing oven." In the same exhibit it is said, referring to the above, "A similar process is now used for rendering kettles and other vessels of cast iron less brittle."
350 In Exhibit 4 reference is made to annealing, in which connection it is said, "Annealing is used to soften a metal after it has been rendered hard by the hammer, and also to soften cast iron, which is rendered very hard and brittle by rapid cooling."

In Exhibit 5 it is said, speaking of the process of annealing glass, "That by gradually cooling the glass becomes perfectly crystalized," to which the following is added: "A similar process is used for rendering cast iron vessels less brittle, and the effect probably depends upon the same principle."

In Exhibit 6 it is said, "Annealing of glass, by the workmen called 'nealing,' consists in placing the bottle, whilst hot, in a kind of oven or furnace, where they are suffered to cool gradually; they would otherwise be too brittle for use. Metals are rendered hard and brittle by hammering. They are therefore made red hot in order to recover their mal-

leability. By the process of annealing the glass is kept for some time in a state approaching to fluidity." In this connection it is said, "A similar process is used for rendering kettles and other vessels of cast iron less brittle." Further, as it is said in connection with the process for converting cast iron into forged, by heat alone, "The cast iron is placed in an air furnace and kept for several hours in a degree of heat by which it is brought near to a fluid state. It is then allowed to cool gradually, and is found to be converted into forged iron. The cast metal should be taken out from the sand of the flasks as soon as it becomes solid and while it is yet red hot."

Ques. 9. State whether or not a person with ordinary knowledge and skill could, from the description contained in the exhibits above referred to, in the art to which they relate, reduce the same to practice or carry into successful operation the process therein described.

Ans. I think any person of ordinary intelligence in relation to metals would have no difficulty whatever in applying the process of annealing, as described in the exhibits referred to.

351 Ques. 10. State whether or not, in the exhibits above referred to, or in any of them, you find a continuous process, i. e., taking the metal while yet hot from the moulds, and while in that state placing it in a previously-heated pit or furnace, and then reheating it, and after this permitting it to cool gradually; and if so, specify one or more.

Ans. In Exhibit 1, the process referred to, as applied to glass and metal rendered brittle by hammering, contemplate reheating; also the keeping of the substance at a high heat, and subsequently cooling slowly. In the same Exhibit, speaking of rendering cast iron malleable, it is said, "The metal is kept for several hours at a temperature a little below its fusing point, and then allowed to cool slowly." I understand that in this description the reheating of the metals is contemplated.

In Exhibit 2 it is provided that cast iron "may be heated in a cinder fire, which must completely envelope and defend the pieces from the air till they are cold." Further on it is said, in the same exhibit, in relation to cast iron: "Heat as many of the pieces as may be convenient, and as soon as they are hot bury them in dry saw dust."

In Exhibit 3 the same idea is contemplated, as shown in the following language: "To avoid this the process of annealing is resorted to, which is nothing more than cooling the heated or melted substance as slowly and equally as possible—often in a separate furnace of the requisite heat—sometimes an annealing oven."

In Exhibit 4, speaking of the methods employed for annealing iron and steel, it is said: "They are generally piled up in an open fire, slowly raised to a red heat, and then allowed as gradually to cool." Further on, reference is made to annealing minute pieces of chilled iron, in which the advantages of annealing, in the manner above directed, is referred to. This manner provided consists in placing the pieces in an oven or trough, of which it is said: "This oven or trough must now be heated by the flames of a furnace, passing under and around it till the
352 whole is of a red heat. It must then be suffered to cool without letting in the air.

In Exhibit 5, in referring to annealing glass, the process is described to consist of putting the glass vessels, while yet hot, into a furnace or oven, not so hot as to remelt them, and in which they are suffered to cool gradually. In the same exhibit (5) it is said, referring to the above: "A similar process is used for rendering cast-iron vessels less brittle."

In Exhibit 6 the process of reheating and slow cooling in contemplated. It is said, "Metals are rendered hard and brittle by hammering.

They are therefore made red hot in order to recover their malleability." Further on it is said: "The cast iron is placed in an air furnace, and kept for several hours in a degree of heat by which it is brought near to a fluid state. It is then allowed to cool gradually." In the same exhibit, speaking of annealing speculums, the following direction is given: "The cast metal should be taken out from the sand of the flasks as soon as it has become solid, * * * * * * * and place the speculum in an iron pot, with a large quantity of hot ashes, or small coals, so as to bury the speculum in them a sufficient depth. Let the speculum remain in the ashes till the whole is become quite cold."

In some of the foregoing processes the idea of reheating from a cold state seems to be implied. In others, as in Exhibits 5 and 6, the processes described provide for taking the metal while yet hot and placing it in an oven, furnace, or pot filled with hot ashes or coals, and then retaining the substance until cool.

Ques. 11. State whether or not the principles involved in the process of Mr. Whitney differ from those set forth in the exhibits to which you have been referred.

Ans. I think Mr. Whitney's process includes nothing new in principles. His process is, I think, fully anticipated, and his apparatus is foreshadowed in the descriptions in the exhibits. He has apparently
353 constructed an annealing furnace, adapted to the specific work of annealing car wheels, which, in its construction and operation, harmonizes with the processes of annealing described in said exhibits, the only difference being in the construction of his apparatus required in adopting it to the specific purpose of annealing car wheels upon the principle of reheating and gradually cooling, as clearly provided in the exhibits referred to, and as familiarly known to the art before his invention.

Ques. 12. State what is the degree of heat exhibited by the walls of the pit in the Mowry process, as observed by you at the works of Mr. Mowry, in Cincinnati, Ohio, after the red-hot wheels are placed in the pit, and before the cover was put on and the joints luted.

Ans. While the hot wheels are being placed in the pit they radiate their heat in all directions, and the walls intercept and receive a portion of this radiated heat, but not enough, I suppose, in the time occupied in filling the pit, to raise the temperature of the walls for any considerable depth beneath the surface. And the walls above the level of any wheel last deposited in the pit, would not, I think, be especially warmed by this radiated heat between the time a wheel is deposited in the pit and the time another is deposited above it. The charcoal placed upon the plate of the wheel, and occupying a space some inches inwardly from the wall, becomes slowly ignited and gives off its heat mainly in an upper direction, but little being given off laterally and communicated to the walls. The heat which would under some circumstances be given off by the hot wheels and the partially ignited coal, and received by the walls, is much less in the Mowry pits, owing to the conditions which in this case obtain. The mouth of the pit is open, and the radiated air produced by the heat of the wheels and burning coal, ascends in a central column, and its place is supplied by an annular current of cold air descending by the walls, and taking up much of the heat given off by the wheels and coal, and thus preventing the walls from becoming as much warmed as they would be under
354 circumstances most favorable. I think the temperature acquired by any part of the wall of the pit above the line of any wheel

last deposited, and in the interval before the deposit of another wheel, would not be raised above a point which could be borne by the hand placed upon it. My information upon this subject is based upon a careful observation of the operation of pitting wheels by Mowry, as practised in his foundry, and made with especial reference to the points embraced in my answer. I noticed particularly that the descent of cold air into the pit, to supply the rarified currents ascending from the pit, was sufficient apparently to absorb the heat and reduce the temperature of the air in the pit, and particularly that portion in contact with the walls, to a very low point—say to a point which could be easily borne by the hand.

Ques. 13. What is the effect of a high degree of heat on the chill of an iron casting?

Ans. I think a degree of heat could be applied to a chill which would modify it and destroy its use as a chill.

Ques. 14. Please explain what kind of a degree of heat you allude to in your last answer, as being a degree which would destroy the chills.

Ans. I do not mean fusing heat, but a degree of heat approaching fusion, or more definitely a degree which would reduce the iron to a semi-plastic state. I think the chill would be modified and impaired, though perhaps not entirely destroyed, at a temperature even less intense than that which would impart plasticity to the metal—say a high white heat.

Ques. 15. In the annealing pit used in Mowry's process, have you found the degree of heat which you describe, or a degree near to it?

Ans. I do not think the temperature of any portion of any wheel in Mowry's pits is raised to a temperature approaching fusion, by several hundred degrees. I do not think the average temperature of any wheel in Mowry's pits is at any time practically raised to a greater
355 degree than that which it had when placed in the pit.

Ques. 16. In Mowry's process, have you observed carefully the combustion of the charcoal when placed upon the red-hot wheel in the annealing pit, and if so, describe it fully, particularly as to the rapidity of ignition and combustion.

Ans. I have examined the operation with particular reference to the point in the question. The heat of the wheel is imparted to the coal, and the coal begins to acquire a red heat very soon. Combustion, however, does not commence immediately in the parts first heated, owing to want of access of air; gradual combustion commences at the edge or margin of the stratum of coal and extends inwardly until at the end of three or four minutes, or the time when another wheel is deposited in the pit, about one-half or two-thirds of the mass of coal is reddened, and combustion has set in upon a portion of the whole, perhaps about one-half of that portion which has been reddened by the heat of the wheel. I notice that the ignition of the coal seemed to be retarded, and the combustion obstructed by the irregular plunging down of volumes of cold air from above, through the mouth of the pit, producing a tumult of currents in the pit.

Ques. 17. Have you read and do you understand the deposition and affidavit of George H. Knight, taken in this case, a copy of which is now shown you, and have you found, and does there exist in Mowry's process, the combustion therein described?

Ans. I have read and do understand the deposition and affidavit referred to in the marked passage, in page 21 of the deposition; it is said, "After the insertion of the first wheel, and, in fact, immediately upon such insertion the furnace starts in active operation, and all the wheels

after the first are manifestly inserted in an already heated pit." I do not find that "the furnace starts in active operation," as stated
356 in the above quotation, but, on the other hand, the combustion of coal starts and continues sluggishly, as I have previously stated, and in place of the pit being "an already heated furnance," as it is termed, the heat imparted to the walls is mainly that given off by and lost from the wheel, to which the heating should be attributed, but a small amount of heat, hardly an appreciable quantity, being given off by the heat of the coal, disturbed and diluted, as it is, by descending currents of cold air. In the marked passage of Mr. Knight's affidavit, page 8, it is said, "The instant that the wheel touches the bed of charcoal it is enveloped in a body of flame and incandescent matter but little inferior in heat to the furnace in Whitney's illustration." I would observe, in reference to this passage in Mr. Knight's affidavit, that it seems to imply a combustion of coal beneath the wheel, and in the space above the floor of the pit. Now as there is no air admitted from below, and all the air to supply the combustion, which is said to envelope "the wheel in a body of flame and incandescent matter," must find its way down from the mouth of the pit, and around through the annular space between the rim of the wheel and the wall of the pit, mixed and diluted with the carbonic acid ascending from the burning coal, a state of combustion, such as is represented in the clause referred to, could not theoretically exist, and, practically, according to my observation, does not exist. The combustion is and must in the nature of the case, be sluggish.

Ques. 18. In the process of Mr. Mowry, describe the difference in degree of heat, if any exists, between the different parts of the wheel at the instant it is deposited in the annealing pit.

Ans. A difference in temperature exists. First the rim has been prematurely cooled by the chill, then the plate being composed of thinner mass of metal, has lost its heat to the sand and air in the process of transfer. Lastly, the hub being a heavy mass, retains more of its heat. I think, practically, the plate is coolest at the time the wheel is pitted, the rim next, and the hub the hottest.

357 Ques. 19. Will you state what you understand by the following words, taken from the complainant's patent: "And the temperature of the furniture or chamber, and its contents gradually raised to a point a little below that at which fusion commences," and "that the temperature of all parts of the wheels deposited therein, may be raised to the same point, (say a little below that at which fusion commences?")

Ans. I understand the first clause quoted in the question to specify and provide that the temperature of the furnace and the contained wheels shall be raised to a point as high as can be attained without fusing the metal of which the wheels are composed. The second clause provides that the heat shall be so applied and prolonged that all parts of each wheel shall be raised to the same point, and that point a little below that at which fusion commences, or, as I understand it, to a point as high as practicable, without melting or fusing the metal.

Ques. 20. What, in your opinion, would be the effect upon the chill of a wheel, if, after being placed on the annealing furnace, it was raised "to a point a little below that at which fusion commences?"

Ans. The effect would be to destroy the chill. In this connection I desire to say, that when I have referred to Mr. Whitney's process in this deposition, I refer to the process as practised by him at his manufactory in Philadelphia, except in cases when the patent or the process described in the specifications, is under consideration.

Cross-examination of William Clough, by complainant's counsel, S. S. Fisher:

Question 1. Describe the ordinary process of annealing, as applied to metals.

Answer. The term is applied to various modes or processes, applicable to different metals, and for producing somewhat different results.

358 In some cases metal is placed in retorts or ovens, and kept at nearly a white heat for some days, or even a week. By this means castings of white iron are rendered malleable. Other modes which provide for shorter and briefer exposure to heat, are employed, when required to provide against unequal strain, and partially remove the brittleness of the metal. Burying metal in ashes, cinders, coals, sawdust, etc., while hot, and allowing them to cool gradually, is extensively practised in the arts, and this is technically called annealing. Heating cast steel to a red heat and plunging it into cold water, removes the temper, and is generally termed "water annealing."

Ques. 2. Is not the first process named in your answer, that ordinarily described in the books as annealing, and is it not applied to the treatment of cold metals, for the purpose of rendering them malleable?

Ans. I believe the books apply the term to all the processes referred to in my answer, though I do not recollect seeing the term "water annealing" in print. It is distinctly referred to the processes of removing the temper from steel, which are malleable before annealing while hot.

Ques. 3. Please point out, in any one of the exhibits to which your attention has been called in the direct examination, a process described for prolonging the cooling of cast metal for the sole purpose of preventing inherent strain, and without reference to softening the iron or rendering it more ductile. Make your reference specific.

Ans. The processes described in the exhibits with general reference to metals and glass, and the prevailing idea through the whole is, that the substances acted upon are rendered less brittle and fragile by the processes. Inherent strain results from the crystalline nature of the substances acted upon, and this is in various degrees modified by the process of annealing, or in other words, the substance is changed from a brittle, fragile state, towards a malleable state.

In Exhibit 1 it is said "A mode has been discovered of rendering cast iron malleable * * * * * * * * * similar to that
359 employed in annealing glass." This idea includes that of relieving the parts of inherent strain—for the fragility of glass, to which the process is allied, results from the inherent strain on the parts."

The same idea is also included in the following from Exhibit 2, "Bodies capable of undergoing ignition, are rendered hard and brittle by sudden cooling. Glass, cast iron, and steel are most remarkably affected by this circumstance, the inconveniences arising from which are obviated by cooling them very gradually." In the same exhibit it is said "Cast iron, when annealed, is less liable to warp by a subsequent partial exposure to moderate degrees of heat." This "liability to warp," which is obviated by annealing, results from inherent strain between the parts.

In Exhibit 3, the brittle or fragile nature of glass is stated to be caused by the strain upon the outer surface of the substance, produced by its sudden or premature cooling, while the internal parts are still in a fluid state, and this state or condition is removed by the process of annealing previously referred to, *which includes as possible.*" And in this

immediate connection it is said a similar process is now used for rendering vessels of cast iron less brittle.

In Exhibit 5, the brittleness of unannealed glass is referred to as a phenomenon, to which is added, "By gradually cooling, the glass becomes perfectly crystallized." This refers to the familiar process of annealing glass, previously described by "A similar process is used for rendering cast iron less brittle, and the effect probably depends on the same principle."

In Exhibit 6 it is said, "By the process of annealing," previously described as "placing the bottles, &c., in a kind of oven or furnace, where they are suffered to cool gradually," the glass is kept for a time in a state approaching fluidity; the heat increases the bulk of the crystallized part, and renders it *os* soft that the internal parts have
360 the opportunity of expanding and forming a regular crystallization. In this immediate connection it is said a similar process is used for rendering kettles of cast iron less brittle.

Ques. 4. Railroad car wheels are cast in moulds with chilled rims, are they not?

Ans. They are cast in moulds with an iron rim called a chilled rim

Ques. 5. What is the purpose of this chilled rim?

Ans. To impart what is called a chill to the tread and flange of the wheel.

Ques. 6. And what is a "chill" in this relation?

Ans. It is a hard and brittle property imparted to the molten metal when it comes in contact with, and is cooled by, the chill.

Ques. 7. What would be the effect upon the "chill" of the ordinary process of annealing?

Ans. As I have formerly stated, the term annealing is variously applied. If the wheel were kept for a long time at a white heat, the chill would be modified and impaired.

Ques. 8. But it is the very purpose of the ordinary process of annealing, to destroy the hardness or brittleness of metal produced by a chill or analogous processes, is it not?

Ans. It is difficult to thoroughly anneal heavy masses of metal, and the annealing process, as ordinarily applied to heavy masses of metal, cannot be said to produce the thorough annealing effect, but only to modify, to a small extent, the brittleness of the metal, and remove inherent strain.

Ques. 8. In point of fact, is not the term "annealing" correctly applied only to a process which softens the metal, impairs its hardness, and in the case of chilled castings destroys the effect produced by the chill.

Ans. I would not undertake to say. The term is variously applied, as I have before said, to processes which differ in degree,
361 though I think they all correspond in kind. The process as applied to the treatment of car wheels, and as is generally termed "annealing," does not destroy the chill.

Ques. 10. You mean that the term annealing as applied to car wheels, does not destroy the chill, referring to processes of slow cooling, such as those of Whitney and Mowry?

Ans. I do.

Ques. 11. Whereabouts in these exhibits do you find a reference to a process of slow cooling, applied to chilled castings of such a character, and of such duration, as to preserve the chill unimpaired while preventing inherent strains in the metal.

Ans. If the question refers to castings in which a chilled condition

is purposely produced in some part of the casting, I do not find specific reference to the same in the exhibits.

Ques. 12. In this respect the processes of Whitney and Mowry agree with each other, and differ from all other processes, to which reference is made in these exhibits, do they not?

Ans. The processes of Whitney and Mowry agree in the respect referred to in the question, but I cannot say that either of them differs from the processes described in the exhibits, for the reason that the said processes contemplate conditions of the metal to be annealed analogous to those produced by the chill in the rim of car wheels.

Ques. 13. But they do not contemplate a condition of the metal in which one portion is rendered hard and brittle by a chill, or analogous process, while the remainder is in the condition of an ordinary sand casting, do they? If so, give the reference.

Ans. They all contemplate a condition of the metal resulting from "a chill," that is—the surface of the metal is always chilled when cast in greensand, and an artificially-induced chill is only more of the same thing.

(Question repeated.)

362 Ans. If the question refers to a chill purposely produced in the process of casting, there is no reference to such a condition in the exhibits.

Ques. 15. I understand you to say, do I not, that the use of the term "annealing" alone gives no indication of the purpose to be attained, or the process to be employed?

Ans. Abstractly none, but its signification would be distinctly understood if used in conncection with any art to which the process is applied. There is no difficulty in determining the process of annealing when used in connection with the manufacture of glass—or when used in connection with the manufacture of malleable iron castings, or when used in connection with car wheels—though the term has a distinction, and somewhat different signification in each connection.

Ques. 16. As a practical man, would you, from the examination of Mr. Whitney's patent, infer that his purpose was to destroy the chill upon the rims of car wheels, or to preserve that chill and prevent the inherent strain resulting from the cooling of wheels cast with it?

Ans. I should not understand his purpose to be to destroy the chill, but should regard his process as incurring great risk of destroying it.

Ques. 17. You have said that "If the wheel were kept for a long time at a white heat, the chill would be impaired." How long a time would be necessary for this purpose?

Ans. The effect would be gradual, commencing upon the surface, and it might require some weeks to effect the reduction of the entire chill.

Ques. 18. What is the depth of a chill upon a car-wheel casting?

Ans. The depth usually aimed at is about three-eighths of an inch. Practically, it varies from a quarter to three-quarters of an inch.

363 Ques. 19. If car wheels are taken from the moulds and placed in a pit, the temperature of which is raised to a point "as high as practicable, without melting or fusing the metal," and then suffered to cool gradually—the entire process being completed in three days, would you say that the chill of the wheels would be modified or impaired by such process?

Ans. Yes; it would be practicable to raise the temperature of the wheels to a point below fusion, at which the chill would be destroyed almost instantaneously. It would, however, be a nice point to attain.

Ques. 20. Do you understand this to be the process described in

Whitney's patent—by the use of the words "a point a little below that at which fusion commences?"

Ans. I do not think Whitney contemplates destroying the chill, but the language of his patent implies distinctly the raising of the temperature of the wheels to a point which would destroy the chill.

Q. 21. If the wheel melted, what part would melt first?

Ans. I think the chill would be fused at a lower temperature than the other part of the wheel.

Ques. 22. Do you mean that the chill would melt before the thin plates between the hub and the rim, if both were placed in the same oven?

Ans. The thin portions would acquire heat sooner than the thick part, but the chill would be reduced to a fluid state at a lower temperature than the grey iron.

(Question repeated.)

Ans. It would depend upon the temperature of the oven. If very intense, the plate would acquire fusing heat before the thick part of the wheel, but if the heat was slowly raised so that all parts of the wheel acquired the same temperature, the chill would be fused before the plate.

364 Ques. 24. In the Mowry pit is not the heat slowly raised according to your theory.

Ans. I don't think the temperature of the wheels is raised in the Mowry pit, that is, the average temperature; the combustion of the coal only supplying the heat lost by radiation.

Ques. 25. At what heat does iron melt?

Ans. At different temperatures, depending upon its nature. I should say 2,500 to 2,800 degrees, F.

Ques. 26. To what temperature can a car wheel be suffered to cool before inherent strain commences?

Ans. The strain commences as soon as all parts of the wheel become hard. I should say after losing a very few hundred degrees from the fusion point. The different parts of the wheel cool unequally.

Ques. 27. In order to prevent such strains, and make a beneficial one of the process of slow cooling, it is necessary, is it not, in Whitney and Mowry's processes, that heat should be applied to the wheel as soon as practicable after they become hard, which shall maintain them for a time at a temperature as nearly as possible below that at which they solidify—or begin to acquire inherent strains, and that they shall then be suffered to cool so gradually as to prevent such strains, and yet so rapidly as to preserve the effect of the chill unimpaired?

Ans. Whitney provides for reheating the entire wheel and retaining the original and acquired heat for the purpose stated in the question. Mowry does not provide to raise the temperature of the whole wheel, but only the plate, allowing the rim to cool from the first, and facilitating the cooling of the heat by a current of air from the first.

Q. 28. For the purposes described in your last answer, both use pits adapted to contain a number of wheels, to which the processes are applied at a single operation, do they not?

Ans. They do.

365 Ques. 29. Both create an artificial heat within these pits by the use of fuel, do they not?

Ans. Yes.

Ques. 30. In both the active operation of the ignited fuel is at the commencement of the process, from which point the fire is gradually suffered to go out, and the wheels to cool, is it not so?

Ans. It is.

Ques. 31. In both this process of gradual cooling, so applied to car wheels, occupies about 72 hours, does it not?

Ans. The usual period is three or four days.

Ques. 32. Where, in all the references to which your attention has been called, do you find a process in the manufacture of car wheels containing the points of identity named in the last four questions?

Ans. I do not find in the references the application of the process to car wheels by their name, except as they are included in the general term "iron castings."

Ques. 33. In order to ascertain more fully what you mean by the phrase, "except as they are included in the general term, 'iron castings,'" I propose to call your attention to these references in detail. Please look at 1. Does that reference describe anything else than, first, a process of annealing glass; second, a process of annealing articles formed of malleable metals; and third, a process of rendering cast-iron vessels malleable?

Ans. In this reference a process is indicated different from that of rendering iron malleable. It is, I think, distinctly implied that vessels are treated only to an extent which removes their brittleness, without providing for rendering them malleable. In other respects the reference is as indicated in the question.

366 Ques. 34. Please to state the exact language that contains that implication.

Ans. In the last paragraph but one it is said, "A mode has been discovered of rendering cast iron malleable, without subjecting it to the process of puddling. The process is somewhat similar to that employed in annealing glass. The metal is kept for several hours at a temperature a little below the fusing point, and then allowed to cool slowly." It is then added, "In this manner vessels are made of cast iron which can sustain considerable violence without being broken." I understand this last clause to mean that the vessels are not rendered completely malleable, as before described, but treated in the same way only to the extent of removing their brittleness.

Ques. 35. In other words, you think that when the author uses the word "malleable," that he means something else. If not, what would any worker in iron understand by the phrase, "rendering cast iron malleable?"

Ans. I think when he uses the term "malleable" he means what he says. And when he describes another operation, in terms which signify a different effect, he does not mean malleable.

Ques. 36. Does not the entire paragraph, after the first ten lines, refer to the description of the process by which cast iron is to be made malleable—by which the author proposes to render "cast iron malleable?"

Ans. The whole paragraph relates to one process, but different degrees of the same process seem to me to be referred to.

Ques. 37. What do you find in Exhibit 1 about taking metals from the moulds in which they are cast as soon as they can be removed, and applying heat to them for the purpose of retarding the cooling?

Ans. I find that the process as applied to metals is said to be
367 similar to that employed in annealing glass, and that in annealing glass it is provided that the substance shall be placed in an oven, where it may take several hours, or even some days, to cool; and this obviously, from the context, provides for taking the glass before it has been once cooled.

Ques. 38. Please explain your analogy as applied to the subject of the last paragraph on the first page of said exhibit.

Ans. In this paragraph reference is distinctly made to the metals which have become brittle by hammering, and not to glass or cast metals.

Ques. 39. It refers to cold metals, does it not?

Ans. It does.

Ques. 40. By what authority do you find the metals to be hot in the subsequent paragraph—is anything said about it?

Ans. The process distinctly referred to the treatment of glass, and in respect to glass the difficulty to be obviated is said to occur when the glass vessel is allowed to cool immediately after being made, and the provision for obviating this difficulty must necessarily include a process which prolongs the cooling from its original hot state.

Ques. 41. Could the process for annealing glass be applied to cold iron castings to render them malleable?

Ans. It could to some kinds of castings.

Ques. 42. Then why do you infer that anything more than the treatment of cold iron castings is meant?

Ans. I do not think that the process as described, and as applied to iron castings, refers distinctly to the temperature at which it is applied, but related as it is to the treatment of glass, the first impression would be that the metals should be taken while hot, as glass is, and subjected to treatment.

Ques. 43. But no difficulty, such as exists in the rapid cooling of glass, is referred to in the case of metal? if so, point out the reference.

Ans. The difficulties existing in metals are the same in kind,
368 though different in degree, from those which exist in glass, that is, inherent strain, which is obviated by the process called annealing. It is said in the reference, "In this (referring to annealing) vessels are made of cast iron, which can sustain considerable violence without being broken."

Ques. 44. Does not the paragraph refer distinctly to a change of structure called malleability, and not a prolonged cooling of original castings?

Ans. It does; and also to a process which does not contemplate malleability of the metal.

Ques. 45. Do you mean to swear that the last lines of the paragraph do not refer to the result of the malleability spoken of in the first lines—may they not do so?

Ans. I mean that this clause, "In this manner vessels are made of cast iron, which can sustain considerable violence without being broken," does not mean that the iron is reduced or changed into a malleable state.

Ques. 46. Why not?

Ans. Because it is not a form of expression which would be used in describing a vessel rendered malleable, but obviously means a vessel rendered less brittle than in its original state, but still susceptible of being broken, like other brittle substances.

Ques 47. Malleable vessels can be broken, can't they?

Ans. Yes; but in speaking or writing of the susceptibility of vessels rendered malleable, it would not be common to refer to their being broken, but rather to their susceptibility of being bent or ruptured. It would not be common to speak of breaking a copper kettle, although it might be ruptured or injured.

Ques. 48. Common or uncommon, there is nothing in the language, as used in the paragraph quoted, which is inconsistent with castings rendered malleable, is there?

Ans. This paragraph states that the cast-iron vessel is so
369 affected by the process that it can sustain considerable violence, that is, a limited degree, or a greater degree than it would support in its original state. If it meant that the metal was rendered perfectly malleable, it seems to me the author would have so stated, and not used an expression which implies that its brittleness was in a measure removed. Certainly there is nothing inconsistent in saying that a vessel of malleable iron will sustain considerable violence without being broken, but there would be no propriety in thus speaking of a malleable iron vessel.

Ques. 49. Where, in Exhibit 1, do you find any reference to the treatment of metallic castings cast with a chill?

Ans. The conditions which the process is designed to obviate results from a chill, properly speaking, and that is necessarily included.

Ques. 50. Is there a word or hint of a chilled casting in the whole exhibit?

Ans. There is not. I find the philosophy of the subject is not explained in this exhibit; the conditions referred to result, however, from the unequal cooling or chilling of some of the parts.

Ques. 51. Then you were in error in your answer to the 49th cross-question, were you not?

Ans. Not in any statement; but there is no reference by terms to chill castings in the exhibit.

Ques. 52. (Question 49 repeated.)

Ans. Nowhere in terms.

Ques. 53. Might not everything that is said of cast metals in said exhibit, refer to those cast in ordinary sand moulds?

Ans. It might.

Ques. 54. What do you find in said exhibit of a process of
370 treating car wheels, and forming one stage of their manufacture?

Ans. No specific reference to car wheels occurs in the exhibit.

Ques. 55. Look at 2. Does that reference describe anything else than, 1st, softening of cast iron; 2d, the annealing of glass; 3d, the annealing of steel; and in so far as the process of annealing is applied to iron and steel, is it not obviously applied to cold metals, and not to castings taken hot from the moulds?

Ans. The process refers to the different substances mentioned in the question, and no others. In reference to annealing cast iron, it is said, "Bodies which are capable of undergoing ignition, are rendered hard and brittle by sudden cooling. Glass, cast iron, and steel are most remarkably affected by this circumstance;" and then, it is said, "The inconveniences arising from which are obviated by cooling them very gradually." This can only refer to a process which includes the cooling from the originally hot state.

Ques. 56. What process?

Ans. The process termed in the exhibit "annealing," which is subsequently described as consisting in heating and slow cooling.

Ques. 57. Does not this process provide for heating the metals in the first instance?

Ans. It provides for heating.

Ques. 58. What do you find in said exhibit about the treatment of castings cast with an iron chill?

Ans. There is no reference in the exhibit to a purposely-induced chill?

Ques. 59. What do you find there about a process of manufacturing car wheels?

371 Ans. I do not find car wheels mentioned in terms, or any other particular kind of casting.

Ques. 60. What do you find in said exhibit of a treatment of metals for the prevention of inherent strains, as distinguished from the ordinary brittleness of all cast metals?

Ans. The distinction is not made; the process is calculated to obviate inherent strain, and that is the principal object for which it is employed in relation to cast metals.

Ques. 61. Does the exhibit say so?

Ans. It says "The inconveniences arising from the brittle condition are obviated by this process."

Ques. 62. What reference do you find in Exhibits 1 or 2, to the prevention of inherent strains arising from the conformation of castings?

Ans. None.

Ques. 63. Look at Exhibit 3. What is referred to in said exhibit besides the annealing of glass, speculum metal, gold, kettles, and cast-iron vessels?

Ans. Nothing else.

Ques. 64. Is not the announced purpose of the process described in this exhibit to render the materials malleable?

Ans. Rather; I should say to the means of rendering substances treated less brittle.

Ques. 65. What do you find about chilled castings, or car wheels, or the prevention of inherent strains?

Ans. It is said, speaking of glass, "That when suddenly exposed, the surface crystallizes and forms a firm shell around the interior fluid parts, by which they become solid, and are prevented from expanding;" this is inherent strain. It is subsequently said that the brittle nature of cast iron, which is obviated by a similar process, admits of the same explanations. Nothing is said in terms of chilled castings, or car wheels, or of any specific castings, except "kettles and other vessels."

372 Ques. 66. Look at Exhibit 4, and state whether, so far as it applies to metals, it does not describe a process to be applied to cold metal, making no reference directly or indirectly to castings taken hot from the moulds, to chilled castings, to car wheels, or to inherent strains.

Ans. I think the process included in this exhibit, as applied to metals, contemplates their treatment from a cold state. No reference in terms to car wheels, or chilled castings, though the condition of inherent strain is included and described.

Ques. 67. Look at Exhibit 5, and state what is specifically referred to therein.

Ans. The brittle conditions of glass resulting from rapid cooling are described, and the mode of obviating the brittleness of the substance by annealing is described. It is then said, "A similar process is used for rendering iron vessels less brittle, and the effect probably depends upon the same principle."

Ques. 68. Look at Exhibit 6, and state what is specifically referred to therein.

Ans. In this exhibit glass is referred to, and the process of annealing to obviate the difficulty, is described. Then a process of converting cast iron into forged, consisting of heating the iron and retaining it at a high heat, and suffering it to cool gradually, is described. A mode of annealing speculum metal is also described, which consists in taking the metal while yet hot, and placing it in an iron vessel with a large quantity of hot ashes and small coals, where it is required to remain until quite cold.

Ques. 69. What do you find in Exhibit 5 or 6, about the treatment of chilled castings, or the manufacture of cast-iron car wheels?

Ans. Nothing in either of the exhibits referring to any particular kind of castings, except in general terms to kettles and other vessels of cast iron and to speculum. No specific reference to chilled castings or car wheels.

(Signed) W'M CLOUGH.

373 *Entry January 28th, 1867, Journal N, p. 126.*

ASA WHITNEY
vs.
ALBERT L. MOWRY. } 534.

This cause came on to be heard upon the original bill and the original and amended answer thereto, and the replication to amended answer, together with the exhibits and testimony, and was argued by counsel, and the court takes the same under advisement.

374 Circuit court of the United States for the southern district of Ohio.

Final decree.—Filed and entered April 5th, 1867, Journal N, p. 183.

ASA WHITNEY
vs.
ALBERT L. MOWRY. } 534.

This suit having been brought to final hearing upon pleadings and proofs, and counsel for the parties respectively having been heard thereon, and the same having been duly considered by the court, it is found and hereby ordered, adjudged, and decreed, that the letters-patent on which the suit is brought, and which are referred to in the bill of complaint, for an improvement in annealing and cooling cast-iron car wheels, granted by the United States to Asa Whitney, bearing date the 25th day of April, 1848, and the extension thereof, are good and valid; that the said Asa Whitney was the first and original inventor of the improvement thereby secured; that the said improvement is useful, and that the defendant, Albert L. Mowry, has infringed upon said patent, and upon the exclusive right of the complainant under and by virtue of the same.

And it is further ordered, adjudged, and decreed, that the complainant do recover of said defendant, the profits, gains, and advantages which said defendant has received, or which have arisen or accrued to him from said infringement of said patent, by the manufacture,
375 use, or sale of cast-iron car wheels, constructed in accordance with the improvement granted and secured by said patent; and also, the said complainant recover of said defendant his costs, charges, and disbursements in this suit to be taxed.

And it is hereby further ordered, adjudged, and decreed, that it be referred to George R. Sage, esq., of Cincinnati, who is hereby appointed as special master of this court for the purpose, to ascertain and take, and state and report to the court an account of the gains, advantages, and profits which said defendant has received, or which have arisen or accrued to him from infringing said patent, by the manufacture, use, or sale of cast-iron car wheels, made by the use of the improvement patented in and by said patent.

And it is further ordered, adjudged, and decreed, that the complain-

ant, on such accounting, have the right to cause an examination of the defendant, ore tenus or otherwise, and also the production of his books, vouchers, and documents; and that said defendant attend for such purpose before said master from time to time, all as said master shall direct.

And it is also hereby ordered, adjudged, and decreed, that a perpetual injunction be issued in this suit, against the defendant, Albert L. Mowry, pursuant to and in accordance with the prayer of the bill of complaint filed in this cause.

376 And afterwards, to wit, but on the same day and in the year last aforesaid, there was issued out of the clerk's office of said court the writ of injunction herein; which said writ is in the words and figures following, to wit:

UNITED STATES OF AMERICA,
Southern District of Ohio, ss:

The United States of America to Albert L. Mowry, and also to his servants, workmen, and agents, and to all and every one of them, greeting:

Whereas it hath been lately represented to us in our circuit court of the United States, sitting as a court of equity that Asa Whitney, a citizen of the State of Pennsylvania, hath exhibited his bill of complaint against you, the said Albert L. Mowry, to be relieved touching matter therein contained, in which bill it is, among other things, set forth that the said Asa Whitney is the owner of certain letters-patent, dated April 25th, 1848, for a certain new and useful improvement in annealing and cooling cast-iron car wheels, duly patented and
377 issued to the said Asa Whitney, and that the said letters-patent are in all respects good and valid, and that they secured to said Asa Whitney, his heirs, administrators, and assigns, from the date thereof, to the expiration of the term of twenty-one years, for which they were granted and extended, the full and exclusive right of making, using, and vending to others to be used, said improvement. And that notwithstanding the laws of the United States, you, the said Albert L. Mowry, have made and used the said improvement in annealing and cooling cast-iron car wheels in infringement of said letters-patent, without the license or consent of complainant.

We therefore, having regard to the matters aforesaid, do therefore command and strictly enjoin you, the said Albert L. Mowry, and your servants, workmen, and agents, and all and every of you, under the penalty of the law thence ensuing, that you and each and every one of you, do from henceforth, and during the unexpired term of said extended letters-patent, absolutely and entirely and perpetually desist and refrain from, directly or indirectly, making, constructing, using,
378 vending, delivering, working, or putting into practice, operation, or use, or in any wise counterfeiting or imitating the said invention, or any part thereof, or any process containing, using, or employing said invention, or any part thereof, or worked or operated in accordance therewith, or like or similar to that which you have heretofore used, or caused to be used, in infringement of said patent, or the rights of said complainant under the same; and from in any way or manner infringing said patent.

Witness the Hon. S. P. Chase, Chief Justice of the United States,

this 5th day of April, A. D. 1867, and of the independence of the United States of America the 91st.

[SEAL.] Attest: JOHN McLEAN, *Clerk.*

SAM'L S. FISHER,
Solicitor for Complainant.

And afterwards, to wit, but on the same day and in the year last aforesaid, came the marshal to whom the said injunction was in form aforesaid delivered for service, and returned the same into the
379 clerk's office of said court with his proceedings indorsed thereon in the words and figures following, to wit:

SOUTHERN DIS. OHIO:

I have executed this writ by delivering a true copy thereof to N. G. Green, Apr. 11, 1867.

A. HICKENLOOPER,
U. S. Marshal,
By W. D. DEMPSTER, *Deputy.*

Entry, May 11, 1867, Journal N, p. 217.

ASA WHITNEY
vs. } 534.
ALBERT L. MOWRY.

On motion to the court it was ordered that the continuance hereinbefore entered in this cause, be and the same is hereby, set aside. And thereupon this cause came on to be heard upon the motion by defendant to modify the decree heretofore entered, and was argued by counsel and submitted; and the court, upon consideration thereof, doth overrule said motion at the costs of said defendant; and this cause is continued.

380 [Robert Clarke & Co., printers, 65 West Fourth street, Cincinnati.]

Circuit court of the United States, southern district of Ohio.

ASA WHITNEY
versus } Before George R. Sage, master, etc.
ALBERT L. MOWRY.

Depositions taken by consent of said parties to be used before George R. Sage, esq., master, etc., duly appointed herein before me, Charles Sergeant, United States commissioner in and for the eastern district of Pennsylvania, and special examiner heretofore appointed in this cause, at the office of A. Whitney & Sons, in Philadelphia, in said district, on Tuesday, the 27th day of August, 1867, when and where the parties attended by their respective counsel, viz: Charles B. Collier, esq., for defendant, and Henry Baldwin, jr., esq., for complainant.

When the said complainant, ASA WHITNEY, having first been duly cautioned, examined, and affirmed, in answer to interrogatories proposed to him, did depose as follows, to wit:

Question 1. Are you said complainant?

Answer. Yes.

381 Ques. 2. Please state what you consider to be the value per

wheel of your patent of April 25, 1848, in the manufacture of cast-iron railroad car wheels, with the particulars of the estimate you place upon it.

Ans. First. The wheel is cheaper, having an average of ten pounds less weight than those treated in the ordinary way. Secondly. The purchaser has that much less weight to transport during the life of the wheel, which, at the minimum price of the cost of transportation for one hundred thousand miles, which we are always willing to guarantee our wheels to run, would be ten pounds, one hundred thousand miles, at one cent per ton (2,000 lbs.) per mile, making this item of saving in transportation, five dollars per wheel. Thirdly. The wheel is more durable, because we can make it harder and free it from all inherent strain, consequently the wheel sells more readily at least by a difference of one dollar a wheel more than those made in the ordinary way.

Ques. 3. What does the saving in weight amount to at the average price of the iron?

Ans. It would be at the present prices for the average size wheels, about four cents per pound—forty cents per wheel.

Ques. 4. What has been the average price of the iron used for car wheels for the last ten years?

Ans. It has ranged from thirty dollars to eighty-five dollars per ton. I suppose it has not been at eighty as long as it was at thirty. I suppose fifty dollars a ton would be a fair average.

Ques. 5. What has been the average price per pound of car wheels, manufactured by your said patented process, during—say, the last ten years?

Ans. From two and a half to five and a quarter.

Ques. 6. At what do you estimate the commercial value of
382 your patented process of April 25, 1848? Give the particulars on which it is based.

Ans. The only sale that I have made amounting to anything, has been to our firm of A. Whitney & Sons for a dollar a wheel, as shown by the books of the firm. We started business in 1847; that was A. Whitney & Son, composed of myself and George Whitney, he having one-third, and I two-thirds, up to 1850. From 1850 to 1861, both inclusive, I was paid a dollar a wheel aside from my proportion of the profits of the business, that amount, one dollar per wheel, being charged to the expense account of the business. Since 1861, I have had different terms of copartnership with my sons, putting in my patent without charging the royalty theretofore paid, the original term of the patent expiring in April, 1862. When the partnership arrangement was made in 1861, it was made without reckoning upon the extension of the patent. The firm were to pay, and did pay, for the extension.

Ques. 7. How long have you retained the exclusive right under your said patent, and manufactured in connection with your sons as above stated?

Ans. From the date of the patent up to this time, with the exception of two licenses, one in January, 1851, and one in February, 1849. The one in 1849, there were a few wheels made under it for which they paid one dollar a wheel, but they did not make a good wheel, and my reputation was suffering from the character of the wheels, and by mutual agreement, the license was canceled. The other license, the party to whom it was granted, made no wheels, and the license was canceled by mutual agreement.

Ques. 8. For how many wheels have you been paid one dollar per wheel by the firm of A. Whitney & Sons?

383 Ans. It appears by this statement that there have been two hundred and thirty-seven thousand four hundred and ninety-four (237,494.)

(The statement is hereto annexed, marked by the examiner, Exhibit "Royalties," and defendant's counsel waives further proof of the correctness of the same.)

Ques. 9. Since the extension of your patent, what has been its value in the manufacture of car wheels compared with its value during the original term per wheel?

Ans. There has been no improvement made that has interfered with it at all, and it is worth just as much per wheel as it was before.

Ques. 10. At what rate per wheel would you have been willing to license this defendant, under your said patent, at any time during the past ten years, if you had done so at all?

(Question objected to by Mr. Collier.)

Ans. My policy has been to decline to grant licenses altogether—though I have had numerous applications for them—in cases where the applicant was to manufacture wheels in regions where we could reach, and furnish as cheap as they could, because it would not be beneficial to them nor to us either. Mr. Mowry was manufacturing in a region where we did reach, and where we had customers all the while. I don't know whether I would have granted him a license or not if he had applied, but if I did, it would certainly not have been at less than a dollar a wheel.

Cross-examined by Mr. Collier, counsel for defendant:

Question 1. Please state how many different kinds of wheels you are, and have been, manufacturing, and give the weights of each kind.

384 Answer. (In answer the witness produces a table marked Exhibit "Sizes and Weights.")

Ques. 2. State the average price received by A. Whitney & Sons for each kind of said wheels each year since 1860, and the average cost to A. Whitney & Sons of each kind of said wheels during the same period.

(Complainant's counsel instructs the witness not to answer, because, first, he is called as complainant and patentee to prove that he has had an established royalty or license fee under his patent for each wheel that he has authorized to be made; that he has maintained a uniform rate of such license fee and royalty; because the manufacturing expenditures and receipts of A. Whitney & Sons, further than the amount paid by them to A. Whitney, patentee, are not legitimate subjects of inquiry on the part of the defendant, and can furnish no criterion for the measure of damages, beyond which question the inquiry is irrelevant, because A. Whitney & Sons are not parties to this proceeding.

The witness, being so instructed, declines to answer.

By reason of the refusal of the witness to answer the foregoing question, counsel for the defendant declines further cross-examination, and now enters his objection to the entire deposition of Mr. Whitney.)

A. WHITNEY.

Affirmed to and subscribed before me this 27th day of August, 1867.

CHARLES SERGEANT,
U. S. Commissioner and Special Examiner.

MEM.—This deposition having been returned by the master, with orders that the witness answer the second cross-question of defend-

385 ant's counsel, the complainant makes answer thereto as follows:

"The whole number of wheels, of all sizes and kinds, made and sold by A. Whitney & Sons, from January 1, 1861, to January 1, 1867, was 251,142; and the average weight of each wheel was 459½ pounds.

"The average price for which these wheels were sold was $15 94
"The average cost per wheel was 13 66

"The average profit per wheel was $2 28
(Signed) "A. WHITNEY."

EXHIBIT "ROYALTIES."

Abstract from A. Whitney & Sons' books of amounts paid Asa Whitney by A. Whitney & Sons for use of his patent in making car wheels, viz:

			WHEELS.		
Dec. 31, 1850.	Journal No. 1.	Folio 305.	10,378.	*a* $1.	$10,378
" " 1851.	" " 2.	" 113.	12,760.	*a* $1.	12,760
" " 1852.	" " "	" 268.	13,351.	*a* $1.	13,351
" " 1853.	" " 3.	" 145.	15,230.	*a* 1.	15,230
" " 1854.	" " "	" 355.	15,490.	*a* $1.	15,490
" " 1855.	" " 4.	" 318.	17,344.	*a* $1.	17,344
" " 1856.	" " 5.	" 190.	32,930.	*a* $1.	32,930
" " 1857.	" " 6.	" 59.	29,850.	*a* $1.	29,850
" " 1858.	" " "	" 273.	13,080.	*a* $1.	13,080
" " 1859.	" " "	" 546.	24,076.	*a* $1.	24,076
" " 1860.	" " 7.	" 109.	30,946.	*a* $1.	30,946
" " 1861.	" " "	" 339.	22,059.	*a* $1.	22,059
					$237,494

A. WHITNEY & SONS,
Kirk, 8 | 26 | '67.

CHARLES SERGEANT,
Special Examiner.

386 EXHIBIT "SIZES AND WEIGHTS."

Sizes and weights of wheels.

Kind of wheel.		24	26	27	28	30	33	36
For engine trucks and tenders, passenger, freight, and other cars of ordinary trains.	4 tread	335	350	.....	400	440	500	585
	4½ tread	.....	380	.....	425	480	560	
For engine trucks and tenders, and cars of fast express trains, and other heavy service.	4 tread	.....	375	.....	430	480	550	
	4½ tread	.....	.....	.....	.....	.....	585	
For coal cars, (used on Lehigh Valley and Lehigh Coal & Nav. Co.'s R. R's.	4½ tread	.....	.....	.....	.....	460		
For street cars	1¾ tread	145	.....	180	.....	210	275	305

CHARLES SERGEANT,
Special Examiner.

Deposition of William Helme.

WILLIAM HELME, a witness produced on the part of complainant, being by me first carefully examined, cautioned, and sworn, in answer to interrogatories proposed to him did depose and say as follows, to wit:

Question 1. Please state your name, age, residence, and occupation.
Answer. William Helme; I am forty-three years old; I am a machin-

ist by trade; I am superintendent of A. Whitney & Sons' car-wheel works; my residence is Philadelphia.

387 Ques. 2. Are you familiar with the process of manufacturing car wheels prior to 1848, especially what were known as split-hub or divided-hub wheels? And if yea, please describe such manufacture?

Ans. I am. Prior to that time wheels were cast with spokes; the hubs divided into three parts to allow the arms to shrink from the center to the circumference. After the wheel was cold, these openings in the hub were filled with wrought-iron keys or composition. There was then a wrought-iron band put on each end of the hub; the band was shrunk on to secure or bind together the hub and keys that filled these spaces. The wheel was then bored and otherwise treated as wheels are now.

Ques. 3. How were the wheels you have just described cooled?

Ans. They were cooled in the open air, as other castings thrown out of the mold.

Ques. 4. State, if you know, the amount and cost of labor and material involved in the finishing of the wheel as you have described above.

Ans. It would take from twenty-five to thirty pounds of wrought iron to each wheel, and a blacksmith and his helper would band and finish about three or four wheels a day. Four wheels would be a good day's work. The blacksmith and helper, with the coal, would cost four dollars and a half to five dollars a day, exclusive of wear and tear of tools. The iron was worth about five cents a pound.

Ques. 5. Are you familiar with the process of treating car wheels patented to A. Whitney April 25, 1848?

Ans. I am.

388 Ques. 6. In treating wheels by that process, what part of the labor and material specified in your answer to question 4 is saved?

Ans. The whole of it.

Cross-examined by Mr. Collier, defendant's counsel:

Question 1. Do you mean to say that, prior to 1848, all car wheels that were manufactured were of the kind you have described, that is, split or divided hub wheels?

Answer. Not all. I mean to say that no single-plate wheel at that time was considered safe. There were some double-plate wheels made, but even they were not considered by many as safe as the spoke wheel with the divided hub, banded with wrought iron, as I have described them.

(All the answer after the words "not all" objected to by defendant's counsel as not responsive.)

Ques. 2. Were not, for many years prior to 1848, car wheels manufactured and used cast with solid hubs?

Ans. Not to my knowledge, except in connection with double-plate wheels.

Ques. 3. Were these made in the manner you have described in answer to the second question in the examination-in-chief?

Ans. The double-plate wheels had solid hubs, and therefore did not require the bands. I have seen wrought-iron bands put on even those, as making them more secure.

Ques. 4. Do you not know of the manufacture of both single and double-plate wheels cast with solid or undivided hubs, and cooled, not in the open air, but by being imbedded in hot or dry sand?

Ans. I have known of such process.

389 Ques. 5. When and where?

Ans. I have known Mr. Lobdell, in Wilmington, to do it. It was about 1861, or 1862.

Ques. 6. What is the comparative cost of wheels manufactured and cooled by the Lobdell process, with those made by Mr. Whitney's process?

Ans. For the same weight of wheel I can't tell exactly. The Whitney process costs the difference of the fuel, Mr. Lobdell using no fuel.

Ques. 7. Does Mr. Lobdell, by the process you have described, make a good wheel?

(Objected to as irrelevant, Mr. Lobdell's process being subsequent to Mr. Whitney's invention, as proved in this case.)

Ques. 8. How long have you been in the employ of A. Whitney & Sons?

Ans. I entered their employment in January, 1862.

Ques. 9. What is the capacity of their establishment?

Ans. We could make three hundred wheels a day.

Reëxamination by Mr. Baldwin.

Question 1. What do you mean when you say the double-plate wheels had solid hubs?

Answer. I mean that the wheel had two plates connected in the center with one solid hub.

Ques. 2. Do you know of a double-plate wheel having a hub divided transversely to the axle?

Ans. Yes, sir; I do.

Ques. 3. When and where?

Ans. Such a wheel was patented either by George Lobdell, or
390 Bush & Lobdell. I only know of their being made at Bush & Lobdell's foundry, now Lobdell's.

Ques. 4. How extensively, to your knowledge, were the solid-hub double-plate wheels made prior to 1848, compared with the split-hub wheels?

Ans. I have no means of knowing, but as far as I know, I don't think it was ten per cent.; ninety per cent. were split hubs.

Ques. 5. How is it now?

Ans. I don't think there are any split hubs now made at all.

Ques. 6. Can you say about how much the manufacture of car wheels has increased since 1848?

Ans. I have no doubt there are ten times as many made now.

WILLIAM HELME.

Sworn to and subscribed before me this 27th day of August, 1867.

CHARLES SERGEANT,
U. S. Commissioner and Special Examiner.

UNITED STATES OF AMERICA,
Eastern District of Pennsylvania:

Be it remembered that, on the said 27th day of August, 1867, I did call and cause to appear before me the aforesaid Asa Whitney and William Helme, at the time and place aforesaid, when and where the aforesaid depositions were reduced to writing by me in the pres-
391 ence of said witnesses, and by them subscribed and affirmed, and sworn to, respectively, in my presence. And I hereby further certify that the said depositions were taken by consent of said parties, to be used on behalf of said complainant, before George R. Sage, esq.,

master, etc. And I further certify that I am not of counsel or attorney for either party in said suit, nor am I either directly or indirectly interested in the result of said suit, and that said depositions have been retained by me for the purpose of being sealed up, addressed, and transmitted by mail to said master.

In testimony whereof I have hereunto set my hand and official seal this 28th day of August, 1867.

CHARLES SERGEANT,
U. S. Commissioner and Special Examiner.

PHILADELPHIA, *February* 12, 1868.

GEORGE R. SAGE, Esq., *Master, etc.:*

The complainant having answered as annexed the question of defendant's counsel, as per your instructions, and further cross-examination being waived, we return herewith the testimony of Mr. Whitney and Mr. Helme as completed.

Very respectfully, your obedient servants,
HENRY BALDWIN, JR., *For Complainant.*
CHA'S B. COLLIER, *For Defendant.*

392 *Deposition of Samuel First.*

SAMUEL FIRST, of lawful age, being first solemnly sworn, deposes and says:

Question 1. State your relation to the defendant, and how long that relation has continued.

Answer. I am his book-keeper at the present time, and have been since July, 1862. I have been in his employ since 1854. Previous to July, 1862, I acted in the capacity of engineer.

Ques. 2. When did Mr. Mowry commence manufacturing annealed car wheels, such as are referred to in this suit?

Ans. My impression has been, since May, 1861, but the books show that he began in April, 1861.

Ques. 3. Who was Mr. Mowry's book-keeper from April, 1861, until July, 1862, when you took charge of them, and where is he?

Ans. Mr. L. T. Corriel was his book-keeper from April, 1861, until July, 1862. He is now secretary of the Queen City Insurance Company, Cincinnati.

Ques. 4. State whether or not the books of Mowry, now presented by you, contain a full and correct account of the wheels annealed, since Mr. Mowry commenced to manufacture car wheels, until the injunction issued in this cause.

Ans. This book is Mr. Mowry's day-book, and contains an account, full and correct, to the best of my knowledge, of all the car wheels sold from the establishment. The entries in the year 1861, and up to the 1st of January, 1863, specify whether the wheels were annealed or not. After the 1st of January, 1863, I think no specification was made in the entries, and the wheels sold, were, with here and there an excep-
393 tion, all annealed. No 36-inch street-car wheels were annealed. The prices stated are those at which the wheels were sold. The entries were made at the dates of the sales. No hand-car wheels were annealed. The entries come down to May 28, 1867. Prior to the 1st of January, 1863, whenever an annealed wheel was sold, it was so specified in the entry of the sale. From April 1, 1866, to July 19, 1866, Mr. William Heaton, who is now in New York City, had charge of the books, and I was absent.

Ques. 5. How many annealed wheels have been sold, if any, since May 28, 1867?

Ans. There have been none sold.

Ques. 6. How many annealed wheels are yet remaining in possession of Mr. Mowry?

Ans. I tried to get an account this morning. I think about 375, or 380, of all sizes. I can not say how many of each size, some of 33, 30, 28, 27, 26, and 24 inch. There are more 33-inch wheels than of any other size.

Ques. 7. The book contains entries of sales of cars—platform, and box, and passenger—without statement as to wheels. How many wheels, and of what size, to a car?

Ans. There are eight wheels to a car, and 33 inches in diameter, unless otherwise specified. I have stated that with few exceptions, the wheels sold after January 1, 1863, were annealed. There are also two exceptions, specially to be noted in 1863, one of seventy-six 30-inch truck wheels, at $14 50, to Mr. Augustus Wessel, in August. (See page 135.) And on the 1st of September, of twenty-four 24-inch wheels, to the same, at $10 50. (See page 138.) These, and the exceptions before stated, are all I know of.

SAMUEL FIRST.

394 On this 11th day of July, A. D. 1867, again came the above-named Samuel First, and further says:

Since giving my testimony above, I have taken an invoice of the annealed wheels, on hand, at A. L. Mowry's establishment and the following is a correct statement of the number.

WHEELS ON HAND.

33-inch	286
30-inch	90
28-inch	15
26-inch	26
Street car	6
Total	423

This invoice was taken on the 10th of June, and exhibits the full number of wheels, to the best of my knowledge.

SAMUEL FIRST.

Recalled:

APRIL 27, 1868.

SAMUEL FIRST, recalled and examined by Henry Baldwin, jr., for complainant, says:

Question 1. State how many different sizes, and the weight of each size, respectively, of wheels annealed by Mr. Mowry, during the period referred in your former examination herein.

Answer. The sizes are:

33-inch
30-inch
28-inch } car and truck wheels.
26-inch
24-inch

The street-car wheels are 30 and 33 inch. These are all the
395 sizes. I cannot state the weights of the sizes of any of them, and the books do not show.

Ques. 2. What kind of iron have those wheels been made from, and how much has been used for that purpose each year, and what was the cost per pound?

Ans. Cold-blast iron was the only kind used, and we did not use that kind of iron for any other purpose except for making chilled tire. For that purpose we used four or five ton per year. The books will show how much iron has been purchased each year, and at what price, but that account is not separate. I will make up a statement from the books, to be attached to this deposition, as a part of my answer to this question.

Ques. 3. Please make out and annex a similar statement of the material, including charcoal or other fuel used in the manufacture of said wheels, and of the labor employed exclusively in such manufacture, in each year; of the repairs to the furnaces and machinery for removing the wheels; of the cost of the pits and patterns and their present value, and of any specific incidental expenses attending said manufacture, so as to show the actual cost of each size of wheels in each year.

Ans. I will do so.

Ques. 4. Do the prices at which said wheels were sold in each year, as stated in the books already exhibited to the master, represent the net price or the gross price at which they were sold; and if the latter, what expense is included therein?

Ans. They represent the gross prices. The cost of delivery, commissions to agents and commission merchants, and Government taxes, are to be deducted from the prices of the wheels as stated on the books.

Ques. 5. You will then please make a statement, or rather in-
396 clude in the statement last called for, the amounts actually paid each year, on each of the accounts in your last answer specified.

Ans. I will do so.

Cross-examination:

Question. 1. Have you at any time made a statement, calculation, or estimate of the profit, if any, per year, or the average profit, if any, since 1861, derived by the defendant from his manufacture and sale of annealed car wheels?

Answer. I have never made an accurate statement.

Ques. 2. Are you able to approximate to the profit per wheel, if any, made by Mr. Mowry, in the manufacture and sale of said wheels?

Ans. I have made an approximate valuation of the profit of a wheel, based upon the prices of iron, and the approximate cost of labor in manufacturing car wheels at two different times.

Ques. 3. When were those estimates made?

Ans. One was made in 1863, and one in 1865.

Ques. 4. What were the elements forming the basis of such calculations, and were they made by you upon an inspection of your books at such times?

Ans. I made the estimate upon the cost of iron and labor, use of machinery, and all incidental expenses connected with the manufacture of the wheels, which includes interest on capital, Government tax, delivery, commission on sales, insurance, State taxes, and repairs. This estimate was made partly from the books and partly from the prices current of pig iron. The books furnished the items of taxes, National and
397 State, insurance, labor, commissions, cost of delivery, and everything in short, except the material, and for that we had the price current.

Ques. 5. Will you state the result of such calculations, and whether the same exhibit, in your opinion, correctly the profit, if any, derived by the defendant for the periods included within such calculations?

(Question objected to for incompetency.)

Ans. The result was that the profit on a wheel amounted to fifty cents; that was the profit on a 33-inch car wheel. I did not approximate the profit on any other wheel. My calculation was for no certain period; my first estimate was made in July, 1863, and the last in February, 1865; this calculation exhibits correctly, in my opinion, the profit derived by Mr. Mowry from the manufacture.

By Mr. Baldwin, for complainant:

Question 1. You estimated interest on capital at what rate and upon what amount?

Answer. Upon one-third of $135,000, I think, about that, the entire capital, at six per cent.

Ques. 2. Was the result the same in July, 1863, as in February, 1865; if not, how did they compare?

Ans. Not exactly the same, the difference was in favor of the approximation of 1863, but very light; that is to say, in 1863 the profits were larger than 1865. Repairs were not so heavy, and it was easier to get the prices for the wheels in 1863 than in 1865, as the market was becoming depressed at the latter date.

Ques. 3. It appears from the books that in July, 1863, the selling price for a 33-inch wheel was $16 50, and in February, 1865, it
398 was $30. Did you regard these prices in those estimates respectively?

Ans. Those estimates were governed by the prices received for the wheels and the cost of material and labor, and the prices considered, in each estimate, were those of the month in which the estimate was made.

Ques. 4. In estimating the cost, you took the actual expenses for the month of July, 1863, and February, 1865, without reference to the expenses of other months?

Ans. I did take the expenses of those months, and no others.

Ques. 5. In February, 1865, it appears by the books you made but 90 wheels; in July, 1863, you made 160; would not the proportionate cost, based upon such an estimate as you have stated, be greater per wheel, the smaller the number of wheels made in the month?

Ans. No, sir; for the simple reason that I have taken the expense of making the wheel only.

Ques. 6. It appears that, in March, 1863, you made 398 33-inch wheels; in September, 705; in December, 785; would not your estimate, if based upon either of these numbers, necessarily have shown a larger profit per wheel than it did, based upon 90 wheels?

Ans. No, sir; for the reason given above.

Ques. 7. As a book-keeper, do you know that an interest account upon manufacturing capital is properly to be credited by the entire production, and that if you charge upon 90 wheels the entire interest on the capital which produces 308 other wheels in the same month, you do not make a fair estimate of the cost of either?

Ans. By the entire production, that is to say that the interest is to be credited with the entire manufacture; that is correct. The
399 item of interest I estimated at 6¼ cents per wheel per day.

Ques. 8. Did you credit the account with materials on hand, purchased during the month, and charged in the expense account in

your estimate, and did you credit any balances, whether of wheels or proceeds, not paid, so as to show accurately what was consumed or expended on the debit side, and what remained on hand and had been received on account of such consumption and expenditure on the other side of the account?

Ans. I did not credit material on hand, nor any balances of wheels or proceeds.

Ques. 9. Then your estimate was simply a rough calculation of this kind; cost of running the shop, including interest on capital for July, 1863, so much; so many wheels made during July, 1863, so much; cost per wheel, therefore, so much; result, so many wheels worth, so much.

Ans. Yes, sir.

Ques. 10. During the two months of these estimates, were not disbursements made and expenses paid which were not requisite every month—as, for instance, repairs, fuel, etc.?

Ans. I don't recollect exactly, but I don't think there were. In 1865 there were some extra repairs. My habit was to average the repair account for the year, and not by the month. There was generally material left over from one month to another.

By Mr. Collier:

Question 1. Are you able to state the cost in labor per wheel for the time when your estimates were made?

Answer. I cannot state that accurately now. I have no memorandum with me to which to refer.

400 Ques. 2. Do you pay your hands by the day or by the wheel?

Ans. By the day.

Ques. 3. Does your number of hands vary from month to month, or is it about the same?

Ans. It does vary.

Ques. 4. If you should manufacture in one month two hundred wheels, and the next five hundred, would your number of hands be increased during the latter month?

Ans. It would.

Ques. 5. About what would be the increase?

Ans. Pro rata.

Ques. 6. Would the increase in the cost of labor due to such increase in the number of hands be more or less for such month than the excess of interest on capital chargeable on the two hundred wheels made in the first month?

Ans. That is a question I cannot answer accurately, because when we were compelled to increase our working force, we had to employ green hands, who couldn't do so much work. The cost of the labor was increased, I believe, enough to balance the interest account, or in other words, equalize the cost of the wheels.

Ques. 7. Have you, during the period since April, 1861, met with any losses in your car-wheel business from bad debts, or otherwise? If so, state what losses, and how incurred.

Ans. I cannot answer that, except upon examination of the books. I will make such examination, and furnish statement to be attached as my answer to this question.

By Mr. Baldwin:

Question 1. How many men does it require to melt the iron and prepare the molds for, and to cast, and pit, and attend to making three wheels per day?

401 Answer. It will require one molder, one helper, one melter, or cupola tender, one breaker, one to make cores, two to pit, one cleaner, that is, nine men. They can make eight wheels per day, but it takes the same number to make three. This does not include the engineer or fireman.

Ques. 2. Then it would take the same force to make seventy-five wheels per month as to make two hundred per month, and would cost as much for one as for the other?

Ans. It would.

Ques. 3. For sixteen wheels per day what additional help would be required?

Ans. It would require four additional men.

Ques. 4. They would double the product then?

Ans. Yes, sir.

Ques. 5. Then the more wheels you make, the less the cost of labor per wheel?

Ans. No, sir; up to sixteen that is true. After that, you have to increase your help in greater proportion.

Ques. 6. Mr. Mowry did not average more than sixteen per day, did he?

Ans. Taking the entire period from 1861 to 1867, he did not.

By Mr. Collier:

Question 1. If you made ten wheels per day, or any number over eight and less than sixteen, how many hands would be required?

Answer. Two extra for any number up to twelve. Above that, four extra.

By Mr. Baldwin:

Question 1. In July, 1863, or in February, 1865, did Mr. Mowry make as many as eight wheels per day?

402 Answer. I cannot say; but both my estimates were made upon the cost of making eight wheels per day.

By Mr. Collier:

Question. 1. Mr. Baldwin's statement of the number of wheels made in July, 1863, and in February, 1865, is derived from the report of sales of those months. Does that account show the number of wheels made, or only of those sold?

Answer. Only of those sold.

By the master:

Question 1. What was the full number of wheels you could make per day, if you worked the foundry to its utmost capacity?

Answer. We never made over forty wheels per day.

Ques. 2. When you made forty wheels per day, how did the cost per wheel compare with the cost when you made eight per day?

Ans. The same.

Ques. 3. In your estimate of interest, how did you get at your six and a quarter cents per wheel?

Ans. By making an average of the annual interest, and dividing that among eight wheels per day, for three hundred and twelve working days to the year.

SAMUEL FIRST.

Deposition of Noyes G. Green.

NOYES G. GREEN, being first solemnly sworn, deposes and says:

Question 1. State your connection with the car-manufacturing business of A. L. Mowry, respondent, and how long you have sustained that relation.

403 Answer. I have been superintendent of the shops about three years.

Ques. 2. Please state the weights respectively of the wheels (annealed) made by Mr. Mowry, of 33-inch, 30-inch, 28-inch, 26-inch and 24-inch.

Ans. The weights will average as follows:

33-inch double plate	505 pounds.
33-inch single plate	485 pounds.
30-inch double plate	475 pounds.
30-inch single plate	425 pounds.
28-inch double plate	380 pounds.
28-inch single plate	350 pounds.
26-inch double plate	330 pounds.
26-inch single plate	280 pounds.
24-inch double plate	310 pounds.
24-inch single plate	280 pounds.

Ques. 3. Does the difference in weight, irrespective of diameter, regulate the prices of Mowry's wheels?

Ans. It does. There is a difference of one dollar between the double and single plate wheels, the double selling for one dollar more, that is, in all railroad car wheels.

By Mr. Collier:

Question 1. Since the decree of the court and the injunction in this case against the defendant, has any annealing process being used by Mr. Mowry?

Answer. No, sir.

Ques. 2. Since you stopped annealing car wheels, has the weight of the wheels, as stated by you, been increased?

Ans. No, sir; it had been reduced.

N. G. GREEN.

404 FRIDAY, *May* 1, 1868.

Samuel First submitted the annexed statement of repairs, with the following explanation:

This statement is partial. It is not complete, but it embraces all the items which appear in the books. There were other charges for repairs which were not so stated, but went into the general expense account. What those other charges were I am not now able to state, nor their amount, even approximately.

Question 1 by master. Did you take the general expense account into consideration in making up your estimate?

Answer. No, sir.

Ques. 2. Can you state what per cent. of the entire amount expended for repairs went into the general expense account?

Ans. No, sir. The account of repairs hereto annexed covers, I would say, about two-thirds of the entire expense of repairs.

SAMUEL FIRST.

Repairs on foundry.

April, 1861.—Painting roof, labor, and material for same	$125 59
November 11.—Repairing stone wall to protect foundation	114 02
March 29, 1862.—Brick and labor repairing stack and cupalo	60 00
April 20.—Repairing iron scaffold	25 00
May 21.—Repairin boiler	125 00
May 10.—Brick and labor repairing wheel pit	40 00
May 15.—Repairing core oven	131 00
May 15.—Repairing foundation core room	141 48
May 15.—Labor on same	25 00
May 15.—Repairing core roof	140 98
October 31.—A. Stewart, for mending tin roof	14 85
November 28.—Dunn & White, for repairing foundry roof	66 14
December.—Lumber and labor repairing crane	20 70
May 3, 1863.—C. Shetland, repairing roof	3 00
May 19.—Brick for repairing cupalo	16 50
May 19.—C. Shetland, roof	5 00
August.—R. B. McCracken & Co	3 00
405 REPAIRS ON FOUNDRY—*Continued.*	
August, 1863.—John T. Webster, repairing wheel pit	$9 00
September 9.—R. B. McCracken & Co., brick and fire clay	6 00
September 9.—C. Shetland	1 25
October 8.—W. Kemper, plumbing	12 40
October 12.—Repairing cupalo shell	58 50
October 12.—Lining cupalo with fire brick	77 50
October 22.—Repairing water meter	2 00
October 22.—Casper Shetland, repairing roof	2 50
December.—Repairing water meter	1 25
January, 1864.—A. Stewart's bill of repairing blow pipe	16 30
January 15.—P. Connelly & Co., repairing sewer pipes	32 13
February.—Repairing cupalo bottom	30 00
April.—A. Stewart's bill, repairing pipe	20 70
April 14.—Washington Kemper's bill of plumbing	12 75
June 25.—Washington Kemper	5 05
July 1.—R. B. McCracken & Co., brick and clay	55 05
July 1.—A. Stewart's bill of repairing pipe	2 50
July 30.—Brick for repairing car-wheel pits	36 60
August.—Repairing foundry door	15 00
August 27.—A. Stewart's bill of repairs	30 80
September 22.—Washington Kemper's bill of repairs	99 26
October 14.—Repairing wheel pits	26 00
October 29.—Repairing foundry roof, by Rust & Deprez	50 00
November 5.—Rust & Deprez, repairing foundry roof	50 00
November 26.—Repairing doors and windows	66 00
December 1.—Rust & Deprez	131 80
December 8.—Hemp cord for sky lights	1 15
December 17.—A. Stewart's bill of repairing pipes	5 30
January 27, 1865.—Rust & Deprez, repairing pipes	32 00
January 30.—Washington Kemper's bill, plumbing repair	19 05
January 30.—Gibner & Hall, freight on wheels (300 33-inch wheels at $30 each)	300 00
February 1.—A. Stewart's bill of repairing	36 50
March 31.—Rust & Deprez	94 50
May 2.—C. T. Dumont	358 68
May 11.—Simon Ross, repairing water meter	14 75
October 27.—Rust & Deprez	5 00
January 22, 1866.—J. B. & T. Gibson, plumbing, repairing water pipe	59 85
January 12, 1867.—Bill of repairing blow pipe	6 96
	$2,541 34

Deposition of Albert L. Mowry.

Question 1. How long have you been engaged in the manufacture of railroad car wheels?

Answer. I commenced the manufacture of railroad car wheels here in the fall of 1851, and have been in the business ever since.

406 Ques. 2. Will you state by what process, if any, you cooled wheels prior to adopting your process as patented to you?

Ans. We usually cooled them in pits covered with dry sand. In some cases I have used air-tight pits without any sand; placing the wheels in the pits, and allowing them to remain there four or five days.

Ques. 3. Will you state what process you have been using for cooling your wheels since the decree of injunction in this case?

Ans. I have simply used pits made of iron sunk in the ground; take the wheels from the mold at the same degree of heat as in the annealing process; place them in the pits without any fuel; cover the pits up; leave the wheels in four or five days; then take them from the pits, and allow them to cool in the open air.

Ques. 4. State whether or not there was any change or difference in the quality of iron used by you after you commenced the annealing process in the manufacture of car wheels?

Ans. I never made any change on account of the annealing process. I always used the best quality of iron. Before and while I was annealing, I always used the best quality of cold-blast iron, which cost $10 a ton more than hot blast. I used always a small amount of iron of old wheels; but, in buying new iron, always bought cold-blast iron.

Ques. 5. Since you quit the annealing process, do you use the same quality of iron as before?

Ans. I do when I can get it. I always use the same qualities. Sometimes I can not get from the same furnaces.

Ques. 6. What difference, if any, was made in the weight or form of your car wheels of different sizes by reason of the annealing process?

407 Ans. We never made any change. The wheels I made before adopting the annealing process, while using it, and since stopping its use, were of the same form and weight.

Ques. 7. What has been the average weights of your different sizes of railroad wheels?

Ans. I will annex hereto a statement, as an exhibit, marked "Exhibit A. L. M., 1;" also a comparative statement, marked "A. L. M., 2."

Ques. 8. Are you able to state, and, if so, will you state the comparative number of 33-inch single and double, and double and single plate combined wheels, made and sold by you during the time you used the annealing process?

Ans. I cannot state the number exactly. To the best of my knowledge and belief we have not made one-twentieth part of the single plate wheels. We seldom made them, except when specially ordered.

(Question and answer objected to, because mere estimates are given; while the facts are, or ought to be, in the knowledge of this witness.)

Ques. 9. Will you state, if you are able, the extent, if any, to which your business of making and selling car wheels was increased by reason of the use of your charcoal-annealing process, under your patent?

Ans. My business never has increased, to my knowledge, by the use of the patented process. I never sold wheels any more readily to railroad companies from the fact of their being annealed. It made no difference in prices. In fact, it was with a great deal of difficulty that I introduced the annealed wheels. The railroad companies preferred the old wheels for one or two years after the new annealed wheels were first introduced. Since I have been enjoined, and have abandoned

408 the annealing process, I have the same customers, and have sold the wheels I have since manufactured without the annealing process as readily as those annealed, and at the same prices.

Ques. 10. State whether the fact of your having ceased the annealing process has been generally known to your customers.

Ans. It has.

Ques. 11. Which is most expensive to manufacture, the annealed or unannealed wheel?

Ans. The annealed wheel is the most expensive. I have always calculated that they cost about twenty-five cents per wheel more than the unannealed, on account of the fuel and labor.

Cross-examination:

Question 1. You now reside in New York, do you not?

Ans. I do.

Ques. 2. How long since you left Cincinnati?

Ans. Two years ago last January.

Ques. 3. During your absence Mr. Noyes G. Green has superintended your car-wheel manufactory, has he not?

Ans. He has been in my employ, acting as my manager. He was in my employ as blacksmith, some two years or longer before that. Prior to my removal to New York, I managed my car-wheel manufactory myself; was at the foundry almost every day; and, since he has been the manager, I have bought a large portion of the iron used myself, and made contracts.

Ques. 4. All the books of that business are kept here, are they not?

Ans. They are.

409 Ques. 5. Is your knowledge of the work done, or wheels made, such that you are better acquainted with their weights and sizes than Mr. Green?

Ans. I do not think so. The way I got my weights was by weighing quite a large number of wheels when Mr. Green and I were both present.

Ques. 6. When?

Ans. Last fall.

Ques. 7. In 1861, or 1862, and from time to time thereafter, did you not publish and circulate a statement of the advantages of your patented annealing process, warning railroad companies not to purchase wheels from John Nash, of this city, because said Nash made his wheels by your patented process?

(Question objected to by counsel for defendant as being irrelevant, and by reason of the fact that the production of such circular or publication, if made, is the best evidence of such fact.)

Ans. I published such a circular.

Ques. 8. Didn't you sue Nash under your patent?

Ans. I did.

Ques. 9. What damages did you claim in that suit?

(Question objected to, for the reason that the record is the proper evidence.)

Ans. I don't recollect.

Ques. 10. You commenced annealing in 1861, I believe. Did you not make and sell a greater number of wheels per annum in 1862, 1863, and 1864, than you had been making and selling prior to 1861?

Ans. Perhaps I made more wheels in 1862, 1863, and 1864, than just prior to 1861, but not as many as between 1855 and 1858, I think. During the war there was a greater number of wheels required.

410 Ques. 11. Between 1858 and 1861 were there not many roads which you have since supplied with annealed wheels, using Whitney wheels?

Ans. All the roads that I have supplied with wheels have, at times, used the Whitney wheels. Ever since I have been in the business, they have always had the Whitney wheels on their roads. They would buy of him and then of me, and of others—Washburne, etc. No road has ever confined itself to a particular wheel—they have bought where they could buy the best wheels, and at the lowest prices.

Ques. 12. Have you not, to a great extent, made it a feature of your business, in soliciting or retaining the custom of railroads, to make your wheels and your prices with special reference, particularly in the earlier years of your annealing, to the competition of the Whitney wheel?

Ans. I have not. No more that wheel than any other. I have had more competition with other parties than I have with the Whitney wheel.

Ques. 13. Have you had more with Nash?

Ans. I have had no more with him; but I have had more with Lobdell and other manufacturers, Whitney's wheel being a different wheel from the wheel I manufacture, his being a single plate, and mine being what I call a single and double-plate combined wheel; was better adapted to this climate; and Whitney's wheel more adapted to a Southern climate, and more liable to crack in a cold climate.

Ques. 14. In changing from the cooling process to the annealing and cooling process, what led you to assume the increased expense involved in this change?

Ans. I was under the impression that I could make a stronger wheel by using charcoal, and thereby increase my business.

411 Ques. 15. Did not the result justify that impression?

Ans. I think the plates of the wheels were stronger. When you anneal in charcoal, or any other way, by raising the wheel to a higher degree of heat than it is when taken from the mold, you soften the tread. The wheels will not wear as well as wheels unannealed. There was no change in my business. In fact, I look upon the annealing process as a humbug.

Ques. 16. In using the sand process, did you leave the wheels in the pits four or five days?

Ans. Four days is the usual time. Sometimes we left them in five, when it was inconvenient to take them out. Many manufacturers only leave them in the sand three days.

Ques. 17. Do you now make the Washburne wheel?

Ans. I make a wheel that is called the Washburne wheel—not exactly after his patent.

Ques. 18. Have you any right, under his patent, to make such wheel?

Ans. I have.

Ques. 19. When did you obtain such right?

Ans. In 1861 or 1862. I have made it in a modified form ever since.

Ques. 20. What form of wheel have you made since you stopped annealing under the injunction in this case?

Ans. The Washburne wheel, (the same as before,) more properly called the Atwood wheel.

Ques. 21. Have you made that wheel in the same form as before the injunction?

Ans. Just the same since the injunction that I did before.

A. L. MOWRY.

412 "EXHIBIT A. L. M., 1."

Sizes and weights of wheels.

Kinds of wheels.	Tre'd.	24	26	27	28	30	33	36
For engine, truck, and tender, passenger, freight, and other cars of ordinary trains, single plate.	3½	288	318	.....	361			
	4	300	328	.....	372	440	488	
	4½	.....	.....	.....	.....	476	519	
Double and single plate combined, for engine, truck, and tenders, for fast trains and heavy service	4	300	324	.....	386	476	505	
For sleeping cars, made by special service by order of one railroad company	4½	.....	.....	.....	.....	.....	566	
Single-plate street cars	1½	.....	.....	.....	169	191	198	
	2½	.....	.....	158	.....	204	208	266

A. L. MOWRY.

413 "EXHIBIT A. L. M., 2."

Comparison of average weights of wheels of same sizes and classes, as per statement in deposition of Asa Whitney, of August 27, 1867, and actual weights of A. L. Mowrey's wheels, as per statement, averages being based on weights of twenty wheels.

Size of wheels.	Av. weights of Whitney's wheels.	Av. weights of Mowry's wheels.	Diff. in favor of Mowry's wheels.	
ORDINARY.				
24	335	296	39	10 wheels weighing 319 lbs. less, making an average of 9-10 lbs. in favor of Mowry's wheel, and in the iron at 4c. per pound, Mowry's wheel would cost $1 27.6 less.
26	365	323	42	
28	412	366	46	
30	460	458	2	
33	530	504	26	
HEAVY SERVICE.				
26	376	324	52	
28	430	386	44	
30	480	476	4	
33	550	505	45	
SLEEPING CARS.				
33	585	566	19	
10	.....	.....	319	
STREET CARS.				
27	180	158	22	4 wheels weighing 145 lbs. less, making average of 36¼ lbs. in favor of Mowry's wheel, with iron at 4c. per pound, Mowry's wheel would cost $1 33 less.
30	210	198	12	
33	275	203	72	
36	305	206	39	
4	.....	.....	145	

A. L. MOWRY.

414 *Deposition of Daniel McLaren.*

MAY 20.

Question 1. Where do you reside, what is your occupation, and how long have you been so occupied?

Answer. I reside in Cincinnati. I am now superintendent of the Cincinnati, Hamilton & Dayton, and Dayton & Michigan, and Cincinnati, Richmond & Chicago Railroads, and have been superintendent of the

Atlantic & Great Western Railway. I have been engaged in the business of superintending twelve or thirteen years, and have been connected with the Cincinnati, Hamilton & Dayton Road since 1851.

Ques. 2. What experience have you had, if any, with cast-iron railroad car wheels, made by the application to the wheels after their removal in a hot state from the molds, of heat, for the purpose of prolonging their heat and gradually cooling them, and what would you designate a wheel thus treated?

Ans. I have been purchasing car wheels and using them in connection with the railroads I have been connected with ever since 1851. I have purchased and used on my roads wheels treated in the manner set forth in the question. I call them annealed wheels—that is the name they go by; but all wheels are more or less annealed.

Ques. 3. If a wheel, after its removal in a hot state from the mold, has no extraneous heat applied to it, but simply allowed to cool by a retention of its own heat, when placed in a pit, or in sand, how do you designate such a wheel?

Ans. I would call that wheel partly annealed; that is, if it has been taken out of its mold and reheated. I have had no experience in
415 the process of handling wheels in the foundry. I only know annealed wheels as I have purchased them by that name.

Ques. 4. Have you purchased from A. L. Mowry, during the past seven years, wheels known as annealed wheels; that is, wheels that were reheated after their removal from the molds?

Ans. Yes. We purchased from Mowry, from time to time, such wheels as were designated annealed car wheels.

Ques. 5. Have you, during such time, purchased from him wheels which were cooled without having heat added or applied to them after their removal from the molds?

Ans. Previous to his getting out the annealed wheels we purchased such wheels. I should not be surprised if we did after that, for I opposed his annealing process.

Ques. 6. What is the difference in the commercial value, if any, between annealed and unannealed wheels; meaning, by the term annealed wheels, those that are removed at a red heat from the molds, immediately placed in heated ovens, then gradually reheated, and suffered gradually to cool; and meaning, by unannealed wheels, those that are removed from the molds at a red heat and allowed to cool in pits or in sand, without being reheated, or having any heat applied to them?

Ans. I would not give a cent more for the annealed wheel than the unannealed wheel; but in certain patterns of wheels would give more for the unannealed than for the annealed wheels. I would prefer a Washburne wheel, made from a proper pattern, unannealed, to any annealed wheel I have seen, because I consider that annealing spoils the chill of the wheel.

416 Cross-examined:

Question 1. Do you consider that annealing, by reheating and slow cooling, strengthens a wheel?

Answer. Yes, I should say it makes the wheel stronger; it makes the iron stronger and toughens it; but, as far as the chill is concerned, I should say it does not improve it; it damages the chill, I believe.

Ques. 2. Then, for safety, the annealed wheel would be better, and the unannealed wheel would be better for wear?

Ans. I am not willing to admit that; I can't admit that.

Ques. 3. Does your road buy Whitney wheels?

Ans. We have bought Whitney wheels; yes, sir.

Ques. 4. Taking the same sizes of each, whose wheels cost your road most, Whitney's or Mowry's, per wheel?

Ans. Mowry's wheels have been the cheapest to our company.

Ques. 5. Whose prices have been the highest per wheel, Whitney's or Mowry's?

Ans. The only wheels of Whitney's that we have purchased were lower than Mowry's at the same time. There was not probably a dollar's difference at that time in price. I am not sure how often we purchased Whitney's wheels; but I think twice; that was several years ago; seven or eight years ago; and none since.

Ques. 6. Has your road at any time received notice from Mr. Mowry not to purchase John Nash's annealed wheels, as they were an infringement of his patent, and he would hold you responsible accordingly?

(Question objected to.)

Ans. Never to my knowledge.

417 Ques. 7. Does your road use Nash's wheel?

Ques. 13. Were Whitney's wheels, at any time since you have been purchasing from Mowry, for sale in this market?

Ans. They have been offered to us through agents.

Ques. 14. What inducements did Mr. Mowry present to your road, in competition with other wheels, as to their strength, cost, guarantee, &c.?

Ans. No inducements whatever were held out to us by Mr. Mowry. As to guarantees, the same as all other wheelmakers; any wheel proving deficient within twelve months, he would replace at his own cost.

418 Ques. 15. Did he make any abatement for difference in freight between distant points and Cincinnati?

Ans. I never had any transactions of that nature with him.

Ques 16. Did Mr. Mowry represent his wheels at any time to be better for being annealed, or partially annealed, or cooled without annealing; or did he claim at any time any peculiar advantage to his wheels by reason of his process for annealing, or annealing and cooling, or cooling?

Ans. Yes, sir.

(Question and answer objected to.)

Ques. 8. Which wheels are most expensive, Nash's or Mowry's? Whose prices are highest?

(Objected to.)

Ans. We don't allow them to make much difference, if any.

Ques. 9. Has your road received any notice from Mr. Mowry that he has stopped annealing his wheels? If so, when?

Ans. I have never received any such notice.

Ques. 10. Have you purchased any wheels from Mr. Mowry since April, 1867?

Ans. Yes, of course we have.

Ques. 11. Do you use standard patterns and sizes, or do you order?

Ans. We take his sizes and patterns for our different size wheels.

Ques. 12. What are the weights—33-inch, etc.?

Ans. Average about 500—30-inch, I don't know exactly what they do weigh—36 we don't use.

Ans. Mr. Mowry at all times wished his wheels to stand on their own merits as to strength and durability. He wouldn't make the representations or claims referred to, to me, and did not, because I was always opposed to his annealing process.

Witness proceeds in the narrative form:

I do not know the Murphy process, nor of Mowry's present mode of

cooling; that is, if he has changed of late, or from his charcoal process. I believe slow cooling of wheels is an advantage, and the contraction of the iron is more uniform. I don't believe a safe car wheel can be made without slow cooling. I do not consider a wheel which is merely left to cool slowly an annealed wheel, or left to cool in the mold. It is not an annealed wheel unless reheated. We run cars from Cincinnati to Buffalo, Toledo, Chicago, Milwaukie, and all over the Western States. I should say the climate in that range of travel does not affect the wheels; climate affects wheels about as rails; strength and durability are the vital requisites of railroad wheels. I think if the iron used in the manufacture of the wheels were properly mixed, and produced a uniform chill in the casting, and the wheel was then uniformly reheated, the chill, if affected at all, would be uniformly affected as
419 to its depth. I have seen a great many wheels broken up. If, in a broken wheel, we find the chill ridgy or uneven, I should attribute it to the improper mixture of the iron in the first place, and not to the subsequent treatment. The chilling property is not possessed by all iron. Wheels wear unevenly by improper application of brakes, sliding, etc. If of uniform depth of chill, wheels generally wear evenly, if brakes are properly used. We have a great many flat places on our wheels caused by the imperfect use of the brakes.

Reëxamination:

I think Mr. Mowry, had he been manufacturing an unannealed wheel, would have been able to compete with Mr. Whitney, as far as our roads are concerned. He sold us no greater number of wheels because he was making annealed wheels. I really don't think he sold us as many. The Whitney wheels were more expensive to us than the Mowry, because they did not wear so well. They were 33 inch single plate, and were sold by the man here who represented himself as agent of Whitney, I think, but I am not sure as to his being Whitney's agent. We bought them as Whitney wheels. A great many men falsely represent themselves as agents. I don't remember whether they bore Whitney's imprint. We bought them because they were cheaper. If we could have bought Mowry's wheels at the same price, we would have taken them.

Recross-examination:

The fact that Mr. Mowry was annealing his wheels made no
420 difference in the extent of our trade with him. To the question, "What converted you from an annealor to an anti-annealor," the witness says: "I never was an annealor." We have been purchasing unannealed wheels from other parties.

D. McLAREN.

Recalled:

Mr. McLAREN being recalled, says: "Since my deposition has been closed, I have ascertained the particulars of the purchase of Whitney wheels therein referred to, and desire to amend my statements respecting the same, as follows:

"I purchased in 1853, through Mr. Wessel, 340 Whitney wheels, 33-inch single plate, as before stated, and I want to obviate any impression that might be conveyed by my previous answers, that said wheels were not good wheels, by saying that they have proved to be good wheels."

D. McLAREN.

Deposition of Richard Bromley.

RICHARD BROMLEY, having been first duly sworn, testified as follows, viz:

Question 1. State your place of residence and occupation.

Answer. Residence is Pendleton, Hamilton County; occupation that of superintendent of machinery of L. M., C. & X. Railroad.

Ques. 2. How long have you been in that occupation, and in what do your duties consist?

Ans. Over twelve years; my duties consist of general charge of rolling stock, machinery, and shops of said company, selection,
421 ordering, and inspection of material required in my department, subject to the approval of the general superintendent of the company.

Ques. 3. Has it been a part of your duty and business to select and inspect cast-iron railroad car wheels; if so, for how long?

Ans. It was in connection with the purchasing agent and superintendent, since my connection with the company in charge of the shops.

Ques. 4. Are you acquainted with the process of annealing, and cooling car wheels patented to Asa Whitney and A. L. Mowry, respectively?

Ans. I am.

Ques. 5. Have you purchased from them, respectively, wheels made according to their patented processes?

Ans. We have purchased wheels represented to have been so made.

Ques. 6. Are you able to tell, from an inspection of a wheel, whether it has been annealed or not?

Ans. I am, if annealed by Mr. Mowry's process. Whitney's annealed wheel is not so distinguishable as Mowry's.

Ques. 7. What, if any, has been your experience and observation with unannealed car wheels, and cooled in the ordinary manner?

Ans. I have had an experience extending over the last eighteen or twenty years.

Ques. 8. Will you state, if you know, what is the difference and what has been the difference, if any, in the commercial value of annealed and unannealed wheels?

Ans. In our purchases we made no difference.

Ques. 9. During the past five or six years, have you purchased from A. L. Mowry, and used on your road any unannealed wheels?

422 Ans. We have.

Ques. 10. Have you paid for those wheels more or less than you paid to him for the annealed wheels purchased at the same time?

Ans. The price was the same in both cases.

Ques. 11. During the past ten years what has been the comparative number of annealed wheels, and those cooled in the ordinary manner used on the roads with which you are connected?

Ans. I have means at hand of knowing the exact proportion. I presume about one-fourth of the number were annealed.

Ques. 12. What do you understand by an annealed wheel?

Ans. A wheel that has been taken out of the mold as soon as the metal is set so as to bear handling, placed in a can or an oven, and the heat increased or continued by artificial heat applied to it and allowed gradually to cool.

Ques. 13. In using the term annealed wheels in the preceding portion of your deposition, do you mean to be understood as describing wheels thus treated?

Ans. I do.

Ques. 14. Are you acquainted with the process of cooling wheels now used by Mr Mowry at his works? If so, state what it is.

Ans. The wheels are taken out of the mold while hot, placed in the cooling cans, each can holding eight to ten wheels, after which the cans are covered, and a current of air allowed to pass through the center of the wheel to partially cool the center; after which the air-hole is closed, and the time of cooling prolonged.

423 Ques. 15. Is any artificial heat applied to the wheels after their removal from the molds, or are they allowed to cool simply by a retention of their own heat?

Ans. There is not. They are allowed to thus cool.

Ques. 16. In speaking of "unannealed" wheels in the preceding portion of your deposition, do you mean to describe wheels treated in the manner last described?

(Complainant's counsel requests defendant's counsel to point out, in any answer given, the use by the witness of any such term as unannealed wheels.

In compliance with the request of complainant's counsel, the defendant's counsel refers to question nine (9) of the foregoing deposition, and the answer thereto, in which the witness is asked whether or not he has purchased and used on the roads with which he is connected, any "unannealed wheels," to which the witness answers in the affirmative, the term "unannealed wheels" being by necessary implication, a part of the answer, and to other questions and answers having the same effect.

Complainant's counsel asks defendant's counsel if the witness has not said, although it does not appear in his answer, "All wheels are annealed."

Defendant's counsel in reply refers the counsel for complainant to the deposition as written by the notary, as containing all the testimony given by the witness, and suggests that what may be understood by the witness, if not fully made to appear by the examination-in-chief, can be elicited by complainant's counsel upon cross-examination.

Complainant's counsel objects to the question as leading and misleading.)

424 Answer to question 16. In that or any other manner of which I have any knowledge not patented.

Ques. 17. In question nine you are asked whether you have purchased or used any unannealed wheels, to which you answer that you have; what did you, and what do you mean by unannealed wheels in that connection?

Ans. Wheels made and cooled under any other process than those of Mr. Whitney or Mowry.

Ques. 18. If a wheel is cooled after its removal from the mold without having artificial or extraneous heat applied to it, would you call it an annealed or an unannealed wheel?

Ans. An unannealed.

Ques. 19. Have you purchased annealed wheels from Mr. Mowry to any considerable extent during the past seven years?

Ans. We have purchased quite a number.

Ques. 20. If, during that period, Mr. Mowry had been making solely wheels unannealed or cooled in the ordinary manner, would your purchases have been greater or less than they have been?

(Question objected to by complainant's counsel for ambiguity.)

Ans. They would up to date have been greater.

Ques. 21. What difference, if any, would have been made in the prices; in other words, would you have paid the same or more or less for wheels cooled in the ordinary manner?

(Question objected to by complainant's counsel as not evidence before the master.)

Ans. In our first experience with annealed wheels, no difference was made in the price; after we became more acquainted with the annealed wheel, we found the chill not as deep nor as uniform as the unan-
425 nealed wheel, consequently not as durable. As to the price there has been no difference. We discontinued the purchase of the annealed wheel.

Ques. 22. In speaking of this effect upon the chill by the annealing process, do you refer to the Whitney wheel or the Mowry wheel, or both?

(Question objected to by complainant's counsel because the witness has not spoken of any effect upon the chill by the annealing process. Question waived.)

Ques. 23. In speaking of this effect upon the chill in the annealed wheels, as observed by you, do you refer to the Whitney wheel or the Mowry wheel or both?

Ans. To both.

Cross-examined by complainant's counsel:

Question 1. What do you understand to be the ordinary manner of cooling car wheels as distinguished from annealing and cooling car wheels?

Answer. All the modes of cooling where no additional extraneous heat is required.

Ques. 2. In other words any mode of slow cooling without reheating?

Ans. Yes.

Ques. 3. As a railroad man, do you not consider that all car wheels now used are, in some sense, and in a greater or less degree, annealed?

Ans. They are not.

Ques. 4. Did you not say during your direct examination these words "All wheels are annealed;" and if yea, what did you mean by that expression?

426 Ans. I made use of the words, but not as a part of my evidence. If not interrupted I would have said "All wheels are annealed, if the representations of wheel manufacturers be true," which, however, I do not believe.

Ques. 5. The interruption you speak of did not come from complainant's counsel, did it?

Ans. It came from both counsels combined.

Ques. 6. Do you consider the Lobdell wheel, made at Wilmington, Delaware, an annealed wheel or an unannealed wheel?

Ans. I am not acquainted with the Lobdell wheel. We have but a very few of them on our road, and I have not examined those.

Ques. 7. In purchasing from Mr. Mowry for your road, whether annealed or unannealed wheels, have you bought such sizes and patterns as he made, or has he made such sizes and patterns as you ordered?

Ans. We used wheels made from his own patterns.

Ques. 8. The weights were the same whether the wheels were annealed or unannealed, I understand?

Ans. They were.

Ques. 9. What was the weight of each size of the wheels supplied by Mr. Mowry for your road, as near as you can state them?

Ans. We use but two sizes, thirty and thirty-three-inch. The thirty-three-inch narrow tread and double plate averaged about five hundred and twenty pounds. The wide tread, same size, were twenty to thirty

pounds more. We use nearly all double-plate Washburne wheel. I don't know the weight of the thirty-inch; think they were about from four hundred and ninety-five to five hundred and ten each. We bought by the wheel and not by the pound.

427 Ques. 10. Which cost your road the most money, the Whitney wheel or the Mowry wheel purchased by you, taking the same sizes from each?

Ans. The Mowry wheel costs the most per wheel.

Ques. 11. I understand you to say that all manufacturers represented their wheels to be annealed wheels; did Mr. Mowry make such representations to you as to his wheels?

Ans. I have understood manufacturers to claim that prolonging the time of cooling had the effect of annealing the wheel. My opinion is, the effect is only an equalization of the strain that would otherwise be in the casting, and that it is not properly annealing. I do not remember that Mr. Mowry made such representations, except as to the wheels annealed by his process, in which charcoal was used.

Ques. 12. Are you familiar with foundry operations, and particularly with the melting and casting of iron?

Ans. As much so as machinists usually are.

Ques. 13. Do you know, and if you do, please state, the shrinkage and contraction of cast iron in cooling?

Ans. The shrinkage varies, according to the quality of the iron, one-eighth of an inch to the foot—to the lineal foot—or one ninety-sixth.

Ques. 14. You know that all irons do not possess chilling qualities?

Ans. I do not.

Ques. 15. Do you know the loss in melting and casting iron, that is to say, how many pounds of casting and scrap are usually obtained from a ton of iron, say twenty-two hundred and sixty-eight pounds to the ton?

Ans. With the proper appurtenances and economy in melting, I would say from two to five per cent. The loss depends much upon the purity of the iron or freedom from dirt.

428 Ques. 16. Is cold-blast iron pure and free from dirt, or otherwise, compared to cheaper irons?

Ans. It is pure as compared.

Ques. 17. Can you state the average loss in melting and casting cold-blast iron?

Ans. I am not specially acquainted with the detail of the business of melting iron to state positively, but presume that three per cent. would be a fair average loss. I have no personal knowledge in the business, but obtain my knowledge from information of men engaged in the business.

(Counsel for the defendant objects to all the foregoing testimony of the witness, as to the waste or loss in the process of melting iron, by reason of the fact that the witness has no personal knowledge on the subject, as is stated by him in his last preceding answer.)

Ques. 18. Have you any personal knowledge of annealing and cooling, or of cooling car wheels?

Ans. I say that I have had explained to me, by Mr. Whitney, his patent process of annealing; have seen his furnace, and understand its operations; and also had an explanation from Mr. Mowry of the annealing process patented by him, and of the cooling process mentioned in my direct examination, as practiced by him; and have also seen wheels buried in sand.

Ques. 19. In addition to these explanations from others, have you

any personal knowledge of annealing and cooling, or cooling processes other than burying wheels in sand?

Ans. None.

(Complainant's counsel objects to all preceding testimony of the witness relative to annealing and cooling processes, because, as stated in the last answer, he has no personal knowledge of them.)

429 Ques. 20. You have been engaged in casting iron, have you not?

Ans. I have not been directly engaged in it as a business. I have never worked at it, but I am familiar with foundry operations from observation.

Ques. 21. You have seen iron melted and cast?

Ans. I have.

Ques. 22. Was the iron weighed before it was melted, and the castings weighed after being cast from that iron, or the loss in melting ascertained within your knowledge; and if yea, how?

Ans. The iron was weighed before casting and the castings afterward. The loss in iron was generally ascertained by charging the foundry with the weight of the iron taken in, and crediting it with the weight of the castings taken out.

Ques. 23. Then your estimate of the loss in castings was based upon your knowledge of foundry operations?

Ans. It was as obtained from the books of the foundry, or from the clerks having charge of the books.

(Question objected to for form, and the testimony of the witness objected to for the reason that the facts stated are not derived from his own personal knowledge on the subject.)

Ques. 24. What foundry do you refer to in your last answer?

Ans. Huston & Clarke, Norwalk, Huron County, O.; Buffalo Steam-Engine Works, Buffalo, N. Y.; the Eagle Foundry, Buffalo, N. Y.; and of the Columbus, O., Machine Manufacturing Co.

Ques. 25. Has Mr. Mowry at any time notified you or your road that he had abandoned his charcoal-annealing process, and was using the cooling process you have described; and if yea, when?

430 Ans. I do not remember that he ever did.

Ques. 26. Is it a matter of consideration with railroads to obtain a strong wheel, or a durable wheel, or a cheap wheel?

Ans. It is to obtain a strong and a durable wheel, believing such a wheel to be the cheapest.

Ques. 27. Do you believe that Mr. Mowry's annealed wheel was as strong as his unannealed wheel?

Ans. I do, if made of the same iron.

Ques. 28. Do you believe that Mr. Mowry's unannealed wheel is as strong as his annealed wheel, assuming both to be made of the same iron?

Ans. For practical use I have been unable to observe any material difference in strength.

Ques. 29. Answer as to the matter of fact.

Ans. The annealed wheel would probably resist a greater number of blows on the side of the plate than the unannealed; but for practical use, I do not consider it superior in strength.

Ques. 30. Please answer categorically which you believe to be the strongest, the annealed or the unannealed Mowry wheel, both being alike in every other respect.

Ans. I do not think there is any material difference; but if any, it it would be in favor of the annealed wheel.

Ques. 31. In buying wheels from Whitney and Mowry, whose prices per wheel were the highest?

Ans. The Whitney wheel was a little the cheapest, but I don't remember exactly the difference. The Whitney wheel was single plate, and the Mowry double plate. I think there was but a dollar's difference between Mowry's single and double plate. The comparison of prices is between Whitney's single-plate wheel and Mowry's double-plate wheel. Whitney's single-plate was cheaper than Mowry's double-plate.

431 Ques. 31. Give, as near as you can, the sizes and weights of the Whitney and Mowry wheels used on your road.

Ans. The sizes were 33 and 30 inch of both manufacturers. I don't know the weight of the Whitney wheel. The Mowry wheel 33-inch narrow tread was about 520 pounds,

Ques 32. Do you still use on your road, and have you purchased recently, any Whitney wheels?

Ans. We have some few Whitney wheels in use, but have not purchased any, I think, within the last three years.

Ques. 33. Before 1861, did your road purchase most wheels from Whitney or from Mowry?

Ans. Purchased from Mowry. Didn't purchase any from Whitney until after that time.

Ques. 34. Have you purchased of John Nash?

Ans. We have.

Ques. 35. From which have you purchased most, Nash or Mowry?

Ans. From Mowry.

Ques. 36. Of which have you most in use now, Nash or Mowry wheels?

Ans. I do not know. Our late purchases have been made from Nash. We have been purchasing principally from Nash, for the last eight or ten months, at least.

Ques. 37. When, and how often have you seen in operation, Mr. Mowry's present process of cooling without annealing, as hereinbefore described by you?

Ans. The description referred to was obtained in conversation with the foreman of the foundry, at the foundry, on the subject of cooling wheels. I did not inspect the process myself, and I have never inspected it personally.

432 Ques. 38. Have you any knowledge of the cooling process known as the Murphy patent?

Ans. I do not know it by name.

Ques. 39. Do you know whether or not Mr. Mowry's present process, which you have described, is a patented process?

Ans. I do not know of my own knowledge.

Ques. 40. Has Mr. Mowry told you that it was?

A. He has not.

Ques. 41. Do you not know that John Nash has continued using the charcoal-annealing process since Mr. Mowry was enjoined from such use?

Ans. I do not, but presume from the appearance of the wheel that he uses charcoal or some other substance to prolong heat.

Ques. 42. In answer to question 20 direct, you say that if Mr. Mowry had been making solely unannealed wheels, or cooled in the ordinary manner, your purchases up to date would have been greater; please explain that.

Ans. The annealed wheels did not wear as well nor as long on the average as the unannealed, which fact influenced our purchases.

Ques. 43. Did the Mowry annealed wheels wear as well or as long as Nash's?

Ans. We have only been using the Nash wheel about a year, consequently have no means of drawing a correct comparison as to the wear. We discontinued the purchase of the Mowry wheel because of an order given by the general superintendent to the purchasing agent to purchase the Nash wheel.

Ques. 44. Is this what you mean by "up to date" in your answer to question 20 in chief?

Ans. It is not. The wear of the Mowry annealed wheel was not satisfactory, and in consequence we purchased wheels of other parties.

433 Ques. 45. Have you never been at Nash's foundry?

Ans. I have been there several times.

Ques. 46. Seen his process?

Ans. I did not pay any attention to it.

Ques. 47. Do you not know that Nash's wheels were annealed with charcoal?

Ans. I do not positively, but from their appearance think they were so annealed.

Ques. 48. Were they purchased for your road as annealed or as unannealed wheels?

Ans. I do not know. Have not examined the invoices in that particular.

Ques. 49. If you have selected, ordered, and inspected wheels for your road, do you mean to say that you don't know whether you have been buying annealed or unannealed wheels for a year past?

Ans. As to wheels, by ordering, I mean drawing requisitions on the purchasing agent for the number and sizes of wheels required. The general superintendent had instructed the purchasing agent to buy the Nash wheel.

Ques. 50. Then in your answer to question 2 direct, you have misstated your office with the railroad, and my questions have been put under some degree of misapprehension. Please, therefore, state how far you select, order, and inspect materials required in your department?

(Question objected to as being argumentative.)

Ans. My business is to make requisitions upon the purchasing agent, (which is technically called ordering,) and generally to name the parties from whom to purchase. I do not go into the market and examine the articles before purchased, but after they are purchased they pass
434 under my inspection, and if I condemn them they are rejected, unless I am overruled by the superintendent of the road.

Ques. 51. In answer to question 16, you say that in speaking of unannealed wheels in the thereto preceding portion of your deposition, you mean to describe wheels to which no artificial heat is applied after their removal from the molds, and which are allowed to cool simply by a retention of their own heat, or in any other manner of which you have any knowledge not patented. Does your idea of an annealing process include any process that is patented?

Ans. It includes the process patented by Mr. Whitney and Mr. Mowry. If there are any others, I do not know of them.

Ques. 52. If Mr. Mowry's present process of slow cooling, which you have described, was a patented process, would you consider it an annealing process?

Ans. I would not.

Ques. 53. In your judgment, is irregularity in the depth of the chill in different segments of the tread of the wheel produced when the wheel is cast, or in the wear of the wheel in use?

Ans. It is produced in the casting or annealing.

Ques. 54. How in annealing?

Ans. By having a greater heat upon one portion of the tread of the wheel than another, or an irregularity in the heat.

Ques. 55. Is this opinion based upon personal knowledge and observation, or simply upon discussion of the subject?

Ans. It is my own opinion derived from observing the wear of the wheels in use, and from breaking wheels and chilled tires that had been unequally heated.

Ques. 56. Please state the range of travel of the cars of your road upon the wheels you use.

Ans. Some of our freight cars run to New York, Boston,
435 Philadelphia, Cleveland, Buffalo, Pittsburg, Chicago, and other western points. Passenger cars, I believe, run no further than to Cleveland.

Reëxamination:

Question 1. Have you been informed by any one of the fact of the disuse by Mr. Mowry of the annealing process? If so, when did you first hear of it?

Answer. I have been informed by Mr. Noyes G. Green and by Mr. Samuel First. I am not certain which gave me the first information, and I cannot tell exactly when, but it has been from six to ten months ago.

RICHARD BROMLEY.

Samuel First recalled.

MAY 22.

Present, Henry Baldwin, jr., for complainant, and A. L. Mowry, defendant.

Question 1. In taking account of stock, have you invoiced on Mr. Mowry's books the iron on hand on the 1st of January of each year at the cost price, or at the then market value?

Answer. At the market value at the time of taking the invoice, without reference to the actual cost.

Ques. 2. State if you know any patents under which Mr. Mowry owns a right, and what right, in connection with the manufacture of car wheels.

Ans. I know that he owns the Washburne right to manufacture his patent car wheel. He also owns the Atwood patent; also the Murphy patent for cooling car wheels. As to this patent, he has the shop-
436 right to manufacture at Cincinnati, at Cleveland, Chicago, and St. Louis; and, in addition, he owns a patent granted to him for an annealing process. His interest in the Washburne patent I cannot state without reference to the deed; that is, what territory it covers. The Atwood right is the right to manufacture at or within twenty-five or fifty miles of Cincinnati, which is exclusive, excepting John Nash and Moore & Son.

Ques. 3. State if it has been a part of your business to conduct any of the correspondence relating to Mr. Mowry's car-wheel business.

Ans. It has.

Ques. 4. State if you have, at any time, as a part of your duty in Mr.

Mowry's employ, or under instructions from him, sent to railroad companies a printed circular respecting his patented charcoal process.

Ans. I have not.

Ques. 5. Do you know that such a circular has been sent by or in behalf of Mr. Mowry?

Ans. I do not.

Ques. 6. Look at the paper shown you, marked "Exhibit G. R. S.," and state if you have seen such documents as that before.

Ans. I have seen that circular, but I do not know of its having been sent out. I saw it in the office. There were probably half a dozen of them. There were but a very few of them up there.

SAMUEL FIRST.

437 "EXHIBIT G. R. S."—CIRCULAR.

Important improvement in annealing car wheels.—Patented May 7th, 1861.

DEAR SIR: I have secured, by letters-patent from the United States, an improvement in annealing car wheels, superior to anything ever before invented for that purpose.

It is well understood that chilled car wheels require to be cooled by a process which will permit the different parts to adjust themselves to each other, and accommodate the unequal contraction of the metal, which results from the process of chilling. For this purpose my invention is made.

The nature of my invention consists in the use of charcoal or other equivalent substance, interlaid with the wheels in the annealing pits, as they are removed from the chills while hot, for the purpose of keeping them up to a proper temperature, prolonging the heat, and permitting them to cool gradually. In the operation of my invention it is found that the wheels, when removed from the annealing pits, are devoid of any strain from unequal contraction, and they afford a much greater resistance to fracture than wheels cast in an ordinary sand mold without the use of a chill.

By this process I am enabled to produce a wheel much lighter and higher chilled, and at least one hundred per cent. stronger than wheels made in the ordinary way, and at the same cost. Many railroad
438 companies are now using my annealed wheels, who will certify to their superior quality over wheels not thus annealed, and I invite the attention of all others to it.

It is proper that I should state that John Nash, of this city, has infringed upon my patent, by annealing car wheels in charcoal, as per my method, and is now offering for sale wheels so annealed. I have prosecuted him for this infringement, and shall hold all those who buy or use these car wheels [so annealed] without my consent, responsible to me, as I have not authorized said Nash to anneal wheels under my improved method.

I am prepared to execute promptly orders to any extent for annealed chilled car wheels, either single or double plated, of any size required. Also, wheels fitted to axles in the best manner at short notice and on the most reasonable terms.

Chilled tires, railroad car and bridge castings, and wrought-iron work, furnished to order at short notice. Your orders are respectfully solicited.

Respectfully, yours,

A. L. MOWRY.

CINCINNATI, * * *

Please examine certificates below.

INDIANAPOLIS & CINCINNATI RAILROAD COMPANY,
President's Office, Cincinnati, March 20, 1862.

This company has had in use for about eighteen months the car wheels manufactured by A. L. Mowry, of this city, in conformity with a new process of annealing, invented and recently patented by him. The process consists in interlaying charcoal, or some equivalent combustible, between the wheels in the annealing pit, (which is also furnished with an aperture for regulating the supply of air to the same,) thus prolonging the combustion of the charcoal, and permitting the different parts of the wheel to adjust themselves to each other during the process of cooling and contraction

439 The wheels in our service have given entire satifaction thus far, and I prefer them altogether to those made by a different and more rapid process. The tests to which I have seen them subjected prove that they are not strained in the process of cooling, and that they are more compact and uniform in texture than others. In one instance, a double-plate wheel, weighing about 510 pounds, was rested on heavy iron bars, and a weight of 640 pounds was dropped upon it from an elevation of 18 feet five times before the wheel was cracked. It then broke in four pieces. A wheel of the same weight, made in the ordinary way, and subjected to the same test, was broken into fragments by the first blow of the hammer. Another single-plate wheel, weighing 475 pounds, was subjected to at least forty blows of a heavy sledge before yielding. The sledge broke an aperture through the plate of just the size of its head, and the wheel was not cracked beside.

I judge that a double-plate wheel made by the process in question, weighing 475 pounds, or a single-plate wheel such as described above, would be abundantly strong for any service, and less liable to fracture than the heaviest wheels ordinarily in use.

I take pleasure in recommending them to railroad companies as superior to any wheels made in the ordinary way.

H. C. LORD, *Pres't I. & C. R. R. Co.*

We did not witness the test referred to, but have no doubt the wheels made under the new process, by A. L. Mowry, are equal to the best made in the country.

W. H. CLEMENT, *Pres't L. M. R. R.*
E. W. WOODWARD, *Sup't.*

440 CINCINNATI, HAMILTON & DAYTON RAILROAD CO.,
Superintendent's Office, Cincinnati, March 20, 1862.

We have had in use on this road for the past eighteen months, Mowry's annealed car wheels, and consider his new process a valuable improvement. I have witnessed a test of the wheels in the same manner as stated by Mr. Lord, and fully concur with him in his statement.

D. MCLAREN, *Sup't C. H. & D. R. R.*

441 WEDNESDAY, *June* 3, 1868.

Samuel First reëxamined.

Question 1, by counsel for defendant. Have you made up an amended statement from the books of A. L. Mowry, of the quantity of cold blast iron purchased by him during the time he manufactured annealed car wheels, and the prices paid therefor? If so, is it complete and correct?

Answer. I have, and it is a complete and correct statement, made up from the bills of purchase; no invoice taken into consideration. I hereto attach the statement marked "Exhibit L. A. Green & Co."

Ques. 2. Have you made up a statement of commissions paid on sales of wheels? If so, how did you make it up, and annex it in lieu of the estimate of commissions heretofore made?

Ans. I have made up such a statement from the books, and it shows just the amounts paid and the times when paid, as appears upon the books. I attach it hereto, marked "Exhibit C. M. N." It is as perfect as I know how to make it.

Cross-examination:

Question 1. Were all the commissions in "Exhibit C. M. N." paid on car wheels sold?

Answer. It was all paid on car wheels excepting the two last items.

Ques. 2. Those items amount to $259 94. What were they paid on?

442 Ans. Those two amounts were paid Parkins, Livingston & Post, commission merchants, at Cincinnati and Memphis, for commissions on car wheels and hand cars. The largest proportion of the amount was paid for car wheels, but I cannot state distinctly the amount paid for each.

Ques. 3. Were the wheels under the hand cars annealed?

Ans. No. I have already stated no hand-car wheels were annealed.

Ques. 4. Were the wheels, on which the commissions were paid to Livingston & Post, annealed wheels?

Ans. The railroad-car wheels were all annealed, but none of the hand-car wheels. I don't know the number of car wheels sold by them, nor the amount of their sales. The commission was 2½ per cent.

Ques. 5. In ascertaining the amount of those two items, did not the books show how much was for hand cars and how much for car wheels?

Ans. The books do show it, but I did not put it down simply because I had not time to do it. It would take half a day to separate the items from the long account with Livington & Post.

Ques. 6. Does the "Exhibit C. M. N.," excepting the two items last referred to, include any commissions paid on anything except annealed wheels?

Ans. I think it does not exhibit any commissions except those paid on annealed wheels. Nearly all of it is specified as paid on wheels. I did not pay all the money myself, and I speak partly from the books.

Ques. 7. In 1861, '62, '63, '66, and 67, were any wheels, other than coal-car or hand-car wheels, made or sold that were not annealed wheels?

443 There were—not made—but sold; that is to say, early in '61 we made some unannealed wheels—before April, 1861, when we began annealing, and sold them afterwards. After we began the manufacture of annealed wheels, we made no unannealed wheels except coal-car, hand-car, and 36-inch street-car wheels. The hand-car wheels there would be no benefit in annealing, as they were spoke wheels.

Ques. 8. Why didn't you anneal the coal-car wheels?

(Objected to for incompetency.)

Ans. Because they were a smaller wheel than the ordinary size of wheel, and in consequence thereof we could not anneal them in connection with the other wheels.

Ques. 9. For what kind of service were the wheels you designate as coal-car wheels, made—where were they to be used?

Ans. They were designated as coal-mining car wheels, to bring the coal from the mine to the mouth of the pit.

Ques. 10. They were not intended to be used with steam or on railroads other than mine tram ways—that is what you mean, is it?

Ans. That is correct—that is what I mean.

Ques. 11. Why did you not anneal the 36-inch street-car wheels?

Ans. For the reason that it would not justify us to go to the expense.

Ques. 12. What expense?

Ans. The expense of building pits for the purpose of annealing them; they were too large to be annealed in the pits we had.

Ques. 13. How is it that no commissions were paid, except as in "Exhibit C. M. N.," upon the large number of wheels made by Mr. Mowry? How were they sold?

444 Ans. Because a part of the wheels were sold directly at the office to the purchasers, and consequently no commissions paid on them. To the best of my knowledge, that was the fact as to all, except what we paid commissions on as shown by "Exhibit C. M. N."

Ques. 14. Name the purchasers referred to in your last answer.

Ans. The Ohio & Mississippi Railroad Company, Cincinnati; Hamilton & Dayton Railroad Company, Little Miami, C. & X. Railroad Company, and Indianapolis & Cincinnati Railroad Company. The Marietta & Cincinnati Road made one or two purchases.

Ques. 15. Are those the only purchasers with whom you dealt directly?

Ans. Those were all that dealt directly at the office—all that I can state.

Q. 16. Did you sell to those roads all the annealed wheels made, except such as were sold on commission.

Ans. We did.

Ques. 17. What is the character of Mr. Mowry's manufacturing business, and why do you attribute to the foundry only a proportion of the capital, machinery, tools, fixtures, buildings, real estate, stock, material, State taxes, water rent, insurance, wear, and tear, and salaries paid by him?

Ans. The character of his manufacturing business is railroad cars, and car wheels and castings. From the fact that part of his investment of capital is in real estate and car works, I attribute only a portion of it to the foundry.

Ques. 18. Is the foundry a separate and distinct establishment from the car shop?

Ans. It is.

Ques. 19. Do you keep an account between the car shop and the foundry?

445 Ans. I do.

Ques. 20. Do you charge the car shop with wheels and castings made, and other work done in the foundry for the car shop?

Ans. I do.

Ques. 21. When a car is made in the car shop, and wheels obtained for it from the foundry, do you charge the car shop with the market price of the wheels, or with their cost?

Ans. With the market price.

Ques. 22. Then your books show the number and prices of wheels required for the car-shop manufacture?

Ans. They do.

Ques. 33. And the account, taken by the master, of wheels sold, in-

cludes the business between the car shop and the foundry, so far as annealed wheels are concerned?

Ans. It does. It includes the account in full, as I know from having compared it with the books.

Ques. 24. Then you mean, in your answer to question 14, that you have sold the roads, therein named, cars as well as wheels?

Ans. I do.

Ques. 25. In taking an account of stock or inventory and balancing your books, say annually, how did you close the account between the car shops and the foundry, or how did you carry forward the balance, if any; in other words, car shop debtor to foundry for wheels, so much; now, how did you credit the car shop?

Ans. I credited car shop by the gross amount manufactured there.

Ques. 26. Then the foundry became debtor to profit and loss
446 for the difference between the price of the wheels and the price of the cars?

Ans. Yes, sir.

Ques. 27. How do you reach the apportionment of capital, etc., heretofore ascribed by you to the foundry?

Ans. By the invoice of stock, patterns, and machinery, and fixtures on hand, and real estate.

Ques. 28. In your foregoing answers you have reference to the entire period during which wheels have been annealed, that is from 1861 to 1867, do you not?

Ans. I do.

Ques. 29. How many wheels to a railroad car?

Ans. Eight, unless otherwise specified.

Ques. 30. Was, at any time, the price of eight car-wheels equal to three-fourths of the price of the car in which they were used?

Ans. They were not.

Ques. 31. Was, at any time, the gross amount of the annealed-wheel business equal to three-fourths of the car-shop business?

Ans. I think not.

Ques. 32. Given eight wheels, at thirty dollars each, two hundred and forty dollars, under a finished car, what was the price of the car, that is, say in 1864?

Ans. A box freight-car sold for one thousand dollars; platform car for eight hundred dollars. We made no passenger cars.

Ques. 33. Look at the papers now shown you, and see if your signature is attached to them, and please state what those papers are.

Ans. These papers are tax returns for A. L. Mowry's personal
447 property, etc., in Hamilton County, for the year 1867. The signature of my name is in my writing.

(Question and answer objected to for irrelevancy.)

Ques. 34. Are you acquainted with the handwriting of William W. Heaton?

Ans. I have seen him write.

Ques. 35. Look at the tax notice now shown you for 1866, and state if his signature is attached to the verification.

Ans. I believe it is his signature.

(Objected to for irrelevancy.)

Ques. 36. Please explain how far the items of those papers embrace the capital, stock, machinery, iron, etc., included in your estimate of Mr. Mowry's investment, which you have fixed at one hundred and thirty-five thousand dollars.

Ans. These statements include only the taxable chattel property.

They do not include the engines, furnace, or boiler, cupola, wheel-pits, or any machinery attached to the realty; but they do include all the iron on hand, the patterns, horses, and wagons, and all other personal property.

Ques. 37. Is the iron on hand included, stated at the market value or cost price?

Ans. At cost price.

Ques. 38. Are those papers the basis upon which the State taxes have been paid by Mr. Mowry?

Ans. To the best of my knowledge, they are; but the taxes include the tax upon the realty and the fixtures attached thereto, and none of those are shown by the tax returns.

Ques. 39. On what proportion of the wheels, made and sold, do you believe, or do you know, drayages have been paid?

Ans. I know of two hundred wheels that we hired drayed that we paid fifty cents per wheel for draying.

448 Ques. 40. Do you know of any more?

Ans. There were others, but I cannot specify them.

Ques. 41. Were not most of the wheels—or what proportion of the wheels cost drayage?

Ans. They all cost drayage, from the simple fact that we have to feed teams and pay drivers when we do it ourselves, and we did not always do it ourselves.

Ques. 42. Is not the value of the teams and wagons or drays included in the capital?

Ans. It is.

Ques. 43. Did you actually dray the wheels?

Ans. We moved them on drays or wagons from the foundry to railroad depots, steamboat wharves, and to the car shop.

Ques. 44. What was the distance from the foundry to the car shop?

Ans. About three-fourths of a mile.

Ques. 45. What proportion of drayage was done by your own teams and wagons?

Ans. I cannot state exactly; probably three-fourths.

Ques. 46. What proportion of the iron was drayed by your own teams and wagons?

Ans. About five-eighths.

Ques. 47. In your statement of repairs you say you have included, you believe, about two-thirds of the entire expense of repairs. Were all of the repairs set forth in your table done for the foundry?

Ans. Yes, sir.

Ques. 48. How many wheels per day has Mr. Mowry made since he stopped annealing, and is he now making?

Ans. From eight to twelve, when the shop runs. We are run-

449 ning every other day, and have been for the past nine months.

Ques. 49. Before that, did you run half time?

Ans. We did. During the years '66 and '67 we ran half time part of the year, and full time part of the year. Say full time one-fourth of the year, and half time the rest of the year.

Ques. 50. You have said that Mr. Mowry owns a right under the Murphy patent. Dy you understand what the Murphy patent is?

Ans. I do.

Ques. 51. Since he was enjoined from annealing, has Mr. Mowry used, or is he now using, the Murphy patent process for cooling his wheels?

Ans. He is not using the Murphy patent at present, nor has he used it at any time since he was enjoined, to my knowledge.

By the master:

Question 1. Will you please state, as nearly as you can, what proportion of the commissions paid Livingston & Post was for the sale of hand cars?

Answer. I believe about three-eighths of the last two items of "Exhibit C. M. N."

Ques. 2. What other castings were made at the foundry during the time you used the annealing process, and how much of the time of the foundry was used in making them?

Ans. Railroad car and engine castings, and street-railroad castings; and I estimate it at about one-fourth of the business of the foundry. We made also bridge castings and chilled tires, and these altogether made up one-fourth of the business of the foundry, and occupied one-fourth of its time.

450 Ques. 3. You speak of sales of wheels with cars. Did you also sell wheels separate from cars; and if so, how large a proportion did those sales bear to the entire sales?

Ans. Yes, sir; the sales of wheels separate from the cars, I believe, would be about five-eight's of the entire sales, and probably three-fourths of the entire sales.

By counsel for defendant:

Question 1. As book-keeper or engineer, while in the employ of Mr. Mowry, was it any part of your duty to determine the conduct of the business?

Ans. It was not; I had no part in managing the business of the concern.

Ques. 2. In answer to the questions upon cross-examination, as to why certain wheels were or were not annealed, were you giving the reasons which actuated the business manager, or your personal conjecture?

(Objected to.)

Ans. I gave it as the knowledge received from the foreman of the shop.

SAMUEL FIRST.

Complainant's counsel offers, and puts in evidence before the master, the record of this case; the same being a printed book subject to correction of errors, if any. And thereupon counsel for defendant waives any objection to which he may be entitled, by reason of the original record not being offered.

And here and now the testimony, at Cincinnati, before the master, is closed.

451 "*Exhibit L. A. Green & Co.*"

	Tons.	Lbs.	Price.	Total.
1861.				
August 5	22	.....	$23 00	$506 00
" 5	7	44	25 00	175 49
" 8	4	1,080	25 00	117 90
November 23	12	465	23 00	280 71
October 27	2	1,134	25 00	62 50
1862.				
April 4	100	50	27 00	2,700 50
" 30	100	1,574	27 00	2,718 73
May 17	8	.....	25 80	206 40
November 15	94	2,130	38 00	3,607 69
August 15	40		30 00	1,200 00
1863.				
March 19	193	944	45 00	8,703 73
June 15	101	1,772	40 00	4,071 25
September 23	111	2,008	45 00	5,034 84
December 4	115	1,475	55 00	6,360 77

	Tons.	Lbs.	Price.	Total.
1864.				
January 7	91	1,832	49 00	4,498 58
February 5	98	2,088	65 00	6,429 84
June 23	206	1,020	65 00	13,419 23
March 14	150	.....	60 00	9,000 00
" 14	7	1,107	65 00	486 28
September 26	57	.....	70 00	3,990 00
August 29	10	905	85 00	883 90
July 28	5	.....	80 00	400 00
August 24	5	314	83 00	426 49
September 9	102	218	77 50	7,912 45
" 9	107	.....	79 50	8,506 50
December 1	35	.....	80 00	2,800 00
November 29	150	.....	75 00	11,250 00
" 29	50	.....	80 00	4,000 00
" 29	100	.....	73 00	7,300 00
" 29	50	.....	73 00	3,650 00
" 29	50	.....	80 00	4,000 00
1865.				
November 13	26	820	65 00	1,713 50
" 23	4	.....	62 00	248 00
July 28	21	182	54 00	1,138 33
June 23	48	1,914	55 00	2,686 42
September 25	25	.....	65 00	1,625 00
October 3	20	1,656	65 00	1,347 46
December 9	22	1,776	62 00	1,412 55
April 4	99	1,794	80 00	7,983 28
July 6	5	1,524	50 00	283 60
December 20	59	1,134	60 00	3,570 00
" 20	17	1,005	70 00	1,221 00
" 20	4	2,042	70 00	343 02
" 20	11	419	70 00	782 93
1866.				
January 15	69	1,456	62 50	4,352 62
February 14	5	.....	75 00	375 00
May 28	50	.....	55 00	2,755 00
September 14	4	.....	67 50	270 00
" 12	5	.....	67 50	337 50
" 10	5	.....	67 50	337 50
" 3	10	364	67 50	685 83
" 1	10	.....	67 50	675 00
" 22	2	.....	67 50	135 00
October 2	97	1,879	65 00	6,358 85
" 24	5	.....	65 00	325 00
November 7	2	230	60 00	126 09
December 20	205	1,232	61 50	12,640 91
	3,012	39,587		178,429 17
1861.				
May 13	15	1,600	26 00	409 38
December 5	9	760	24 00	224 04
	3,054	1,213		$179,062 59

Average price per ton	$58 63 1-5
Transportation and drayage	2 00
	$60 63 1-5

452 "EXHIBIT C. M. N."

Amount paid commission on sales of car wheels.

1861.					
November	Commission	on	wheels		$50 00
1862.					
October	"	"	"		100 00
1863.					
January 23	"	"	"		75 00
February 28	"	"	"		520 00
1866.					
January 22	"	"	"		50 00
October	"	"	"		100 00
December	"	"	"		127 63
1867	"	"	"		132 31
					$1,154 94

1861.			1862.			1863.			1864.			1865.			1866.			1867.		
On hand Jan. 1st, per invoice.	Bought.	Price per ton.	On hand Jan. 1st, per invoice.	Bought.	Price per ton.	On hand Jan. 1st, per invoice.	Bought.	Price per ton.	On hand Jan. 1st, per invoice.	Bought.	Price per ton.	On hand Jan. 1st, per invoice.	Bought.	Price per ton.	On hand Jan. 1st, per invoice.	Bought.	Price per ton.	On hand Jan. 1st, per invoice.	Bought.	Price per ton.
Tons.	*Tons.*	$	*Tons.*	*Tons.*	$	*Tons.*	*Tons.*	$	*Tons.*	*Tons.*	$	*Tons.*	*Tons.*	$	*Tons.*	*Tons.*	$	*Tons.*	*Tons.*	$
266½	.....	27 00	100	.....	26 00	152	.....	46 00	130	.....	60 00	355½	.....	80 00	100	.....	63 00	196	.....	60 50
.....	178	28 00	.....	2	25 00	.....	101	40 06	.....	91	49 00	.....	48	55 00	.....	69	62 50	47	.....	54 50
.....	2	25 00	.....	100	27 00	.....	192	45 00	.....	98	65 00	.....	21	54 00	.....	5	75 00	.....	.....	.....
.....	.....	.....	.....	40	30 00	.....	6	40 00	.....	150	60 00	.....	20	65 00	.....	50	55 00	.....	.....	.....
.....	.....	.....	.....	94	38 00	.....	111	45 00	.....	7	65 00	.....	4	62 00	.....	24	67 50	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	115	55 00	.....	180	65 00	.....	22	62 00	.....	2	67 30	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	9	65 00	.....	26	65 00	.....	97	65 00	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	5	77 50	.....	.....	.....	.....	5	65 00	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	10	85 00	.....	.....	.....	.....	205	61 50	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	57	70 00	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	102	77 50	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	5	83 00	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	107	79 50	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	150	75 00	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	50	80 00	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	100	73 00	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	50	73 00	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	50	80 00	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	25	80 00	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	10	80 00	.....	.....	.....	.....	.....	.....	.....	.....	.....
266½	180	.....	100	236	.....	152	525	.....	130	1,256	.....	355½	141	.....	100	457	.....	243	.....	.....

454 *Labor.—Wages paid 9 hands (making 8 wheels per day) in each year.*

Year.	One hand at—	One hand at—	One hand at—	Six hands at—	Total cost of labor for 8 wheels per day.
1861	$2 25	$1 75	$1 25	$6 50	$11 75
1862	2 25	1 75	1 25	6 50	11 75
1863	2 25	1 75	1 25	7 00	12 25
Oct., Nov., Dec.	2 25	1 75	1 50	9 00	14 50
1864	2 71	2 71	2 00	10 00	17 42
1865	3 75	2 71	2 50	11 18	20 14
1866	3 50	2 71	2 25	11 00	19 46
1867	3 75	2 71	2 25	11 00	19 71

State taxes paid on foundry, chargeable to wheel account, being three-fourths of total taxes paid.

1861	$230 52
1862	217 41
1863	409 23
1864	871 86
1865	513 35
1866	310 23

Water rates paid, chargeable to wheel account, being two-thirds of entire amount paid.

1861	$40 00	⅔	$26 67
1862	40 00	⅔	26 67
1863	48 00	⅔	32 00
1864	80 00	⅔	53 34
1865	80 00	⅔	53 34
1866	80 00	⅔	53 34

455 *Charcoal, coke, sand, and flour.*

	Per 100 wheels.	Per wheel.
Charcoal	.....	.15
Sand (moulding)	$24 00....	.24
Sand (sharp)	5 00....	.5
Flour	15 00....	.15
Coke	58 00....	.58
Average cost (in 1861, '2, '3, '4, '5, '6, & '7)		$1.17

Insurance paid on foundry, chargeable to wheel account, being three-fourths of entire amount paid.

1861	$225 00
1862	225 00
1863	225 00
1864	225 00
1865	255 00
1866	225 00

Capital and interest.

The ground, buildings, machinery, tools, and fixtures occupied and used by A. L. Mowry, in his car shop and foundry, are estimated at $135,000, of which $35,000 is for stock or materials. Of this sum ($135,000) one-third is attributed to the car-wheel business, say $45,000, at 6 %, gives $2,700 per annum for interest on capital.

456 *Wear and tear estimated on foundry and appurtenances, $8,000, of which three-fourths is for wheel account.*

1861, 9 months,	10 % per year	$450 00
1862,	" "	600 00
1863,	" "	600 00
1864,	" "	600 00
1865,	" "	600 00
1866,	" "	600 00
1867, 3 months,	" "	150 00

Salaries paid First & Green so far as chargeable to wheel account.

1861	$337 50	$675 00	$1,012 50	9 mos.
1862	450 00	900 00	1,350 00	per an.
1863	450 00	900 00	1,350 00	per an.
1864	500 00	900 00	1,400 00	per an.
1865	600 00	900 00	1,500 00	per an.
1866	700 00	900 00	1,600 00	per an.
1867	175 00	225 00	400 00	3 mos.

Drayages.

Paid on iron	$2 00	per ton.
" " wheels	2 00	" "

Month.	1863.			1864.			1865.			1866.			1867.			License.
	Tons.	Per ton.	Amount.	Tons.	Per ton.	Amount.	Tons.	Per ton.	Amount.	Tons.	Per ton.	Amount.	Tons.	Per ton.	Amount.	‡ of tax.
January	.....	.....	.....	56¼	1 50	$84 63	75½	$3 00	$226 50	83	3 60	$298 80	95½	3 00	$286 50	1863, '4, '5, '6, '7, five years, at $7 50 per year.....$37 50.
February	.....	.....	.....	78	1 50	117 00	37	3 00	111 00	155	3 60	558 00	38	3 00	114 00	
March	.....	.....	.....	46¾	3 00	140 25	33	3 00	99 00	45½	3 60	163 80	29½	3 00	268 50	
April	.....	.....	.....	155	3 00	465 00	48	3 60	172 80	20¾	3 60	74 70				
May	157½	3 00	472 58	53	3 00	159 00	36	3 60	129 60	67¼	3 60	242 10				
June	.....	.....	.....	39½	3 00	117 75	51	3 60	183 60	43½	3 60	150 31				
July	.....	.....	.....	140	3 00	420 00	123½	3 60	444 60	40½	3 60	144 90				
August	98¾	1 50	148 25	77½	3 00	231 75	41	3 60	147 60	62	3 00	186 00				
September	51½	1 50	77 25	111	3 00	333 00	61	3 60	219 60	170	3 00	510 00				
October	62½	1 50	93 37	77	3 00	231 00	53	3 60	190 80	162	3 00	486 00				
November	64	1 50	96 00	86	3 00	258 00	134	3 60	482 40	121	3 00	363 00				
December	66½	1 50	99 75	229½	3 00	688 50	178	3 60	640 80	165	3 00	495 00				
Total	500¾	.....	$987 20	1, 150¾	.....	$3, 245 88	871	.....	$3, 048 30	1, 133½	.....	$3, 672 61	233	.....	$669 00	

458 *Summary of above table.*

Year.	Tons.	Taxes.
1863	500¼	$987 20
1864	1,150⅜	3,245 88
1865	871	3,048 30
1866	1,133½	3,672 61
1867	223	669 00
Total	3,878⅛	$11,622 99
License		37 50
		$11,660 49

Commissions paid from 1861 to 1867—April to April—estimated by First at, say $600 00

Bad debts and discount on bills.

Jan., 1865—Paid discount on quartermaster's vouchers...	$12,803 43	
1864—Fulton Manufacturing and Coal Mining Co., wheels and axles.....	521 81	
1867—February—L. A. Danby, wheels and axles....	536 00	

And in answer to questions respecting the above items—

SAMUEL FIRST says that the discount on Quartermaster's vouchers was on the amount of a contract made by Mr. Mowry with the Government for 304 railroad cars; the amount of vouchers received by him in settlement of said contract was $106,695 25, which he discounted at 12 per cent., making the above amount of $12,803 43. These cars were supplied with 8 wheels each, (33-inch single plate,) or 2,432 wheels. As to the two items of $521 81 and $536, he says they are accounts due Mr. Mowry for wheels and axles. The one of $521 81 he believes to be bad, but it was for coal-car wheels that were not annealed, and the one for $536 he considers doubtful.

And he says that he should estimate the axles to represent ⅛ of each of said two accounts.

	1862.		1863.		1864.		1865.		1866.		1867.	
	No.	Invoice price.	No.	Invoice price.	No.	Invoice price.	No.	Invoice price.	No.	Invoice price.	No.	Invoice price.
33-inch double plate							294	$23 00	19	$23 75	*1 68	$21 75
33-inch single plate	137	$13 00	258	$16 00	312	$19 00	432	22 00	111	23 75	*2 343	21 00
30-inch double plate							67	22 00	11	22 75	129	20 00
30-inch single plate	*1 155	12 00	63	14 50	62	18 00	7	21 00	22	21 75	86	20 00
28-inch double plate									26	22 75	*3	19 00
28-inch single plate			5	14 00	4	18 00			5	21 75	7	20 00
											4	12 00
26-inch double plate							8	20 00	11	21 50	*3	519 00
											33	18 00
26-inch single plate			11	14 00	11	10 00			3	20 00	7	10 00
24-inch double plate							*1 11	19 00			10	17 00
24-inch single plate			24	10 50	4	9 00			*1 20	18 00	7	16 00
									11	13 00		
33-inch street car	28	8 00	24	8 50	2	10 00	24	10 00	10	12 00	27	12 00
					*1 8	4 00	*2 8	9 00				
30-inch street car	*2 14	8 00	9	8 00	2	9 00	9	9 00	*2 2	10 00	6	11 00
Totals	*3 334		*1 394		*2 405		*3 860		*3 251		*4 735	

MEM.—1862—*1. Invoiced as "26, 28, and 30 inch wheels."
" —*2. Invoiced as "27, and 30 inch street-car wheels."
" —*3. Whether any of these were double plate wheels is not shown by the books.
1863—*1. Whether any of these were double plate wheels is not shown by the books.
1864—*1. These (8) were 27-inch street-car wheels.
" —*2. The books designate these as single-plate wheels.
1865—*1. From the price deemed to have been double-plate wheels.
" —*2. These were "27-inch street-car wheels."
" —*3. Designated on the books double or single plate, as entered in the table.
1866—*1. From the price deemed to have been double-plate wheel.
" —*2. "Coal-car" wheels not annealed.
" —*3. Designated on the books double or single plate as entered in the table.
1867—*1. These were sold for $19 00 each.
" —*2. These were double-plate narrow tread.
" — 3. These were 27-inch double-plate wheels.
" —*4. Designated on the books double or single, as entered in the table.

460 In answer to a question, Samuel First says a ton of iron is 2,268 pounds.

In answer to a question, Samuel First says that old wheels bought for and used in making new wheels cost about the same as cold-blast iron. The prices paid for old wheels was from 1¾ to 2½ cents per pound, but the witness estimates a loss of one-fifth in the weight of such wheels, and the cost, therefore, as high as iron. The old wheels purchased by Mr. Mowry were used for no other purpose than the making of new wheels.

Noyes G. Green says that the 33-inch and 30-inch street-car wheels weighed two hundred and twenty pounds each.

It is agreed that the foregoing transcripts and tables are furnished by Samuel First as correct transcripts from the books and vouchers of A. L. Mowry, and as his answers to the calls for such facts as appear therein; and it is further agreed that the same may be used before George R. Sage, esq., master, &c., in taking the account, &c., in Whitney v. Mowry, as part of the deposition of said Samuel First, taken April 27, 1868. And the above statement of Noyes G. Green, as to the weights of street-car wheels, is also admitted as part of said Green's deposition.

HENRY BALDWIN, JR.,
For Asa Whitney, Complainant.
CHA'S B. COLLIER,
For A. L. Mowry, Defendant.

CINCINNATI, *May* 15, 1868.

461 United States circuit court, southern district of Ohio.

ASA WHITNEY
vs.
ALBERT L. MOWRY.

The commissioner having advised with the district judge, herewith returns to Messrs. Baldwin and Collier, Philadelphia, of counsel, the deposition of Asa Whitney, taken at Philadelphia, August 27, 1867, with the following order:

Ordered, That the witness, Asa Whitney, be recross-examined; that he answer question No. 2 proposed by counsel for defendant, and such other questions as may be put to him, and that his answers be attached to and made part of the deposition.

The commissioner suggests that it is not, by the above order, intended to pass upon the competency of the testimony sought for, but that the proper course is to take the testimony that the commissioner and the court may be enabled to decide as to its competency. If the witness still refuses to answer, an application should be made to the judge of the court at Philadelphia to compel him.

GEORGE R. SAGE,
Commissioner.

462 United States circuit court, southern district of Ohio.

[Before Geo. R. Sage, esq., master.]

ASA WHITNEY
vs.
A. L. MOWRY.

It is hereby agreed that the following statement is admitted as part

of the deposition of Noyes G. Green before the master, and as part of the stipulation in this behalf, dated "Cincinnati, May 15, 1868."

"Noyes G. Green says that the loss in melting and casting iron is ten per cent.; that is, a ton of iron, 2,268 pounds, gives 2,041 pounds of car wheels."

Said statement to be deemed and taken as in evidence before the master as of the date of said stipulation.

It is further agreed that the case before the master, so far as the taking of testimony is concerned, is now closed, and that the report shall, if then filed, be considered by the court as early in October next as possible.

HENRY BALDWIN, JR.,
For Compl't.
CHARLES B. COLLIER,
For Def't.

PHILA., *July* 15, 1868.

463 TESTIMONY TAKEN BY THE MASTER.

Samuel First recalled.

JUNE 9.

By the master:

Question 1. You have fixed $45,000 as the sum to be charged as capital to the car-wheel business. In making this estimate did you take into consideration that one-fourth of the time and labor of the foundry was devoted to other castings?

Answer. I did; and the $45,000 does not include the entire capital invested in the foundry, but only the proportion which ought to be charged, according to my judgment, to the car wheel business.

Ques. 2. You estimate a loss of one-fifth in the weight of old wheels. How do you make that out?

Ans. Wheels that have been worn out by use under cars accumulate great quantities of dirt, which adheres to the wheel with the oil used for lubricating; this dirt adheres to the outside of the wheel, and in double-plate wheels fills in a great measure the space between the plates, and we had to buy the dirt as well as the wheels. Upon reflection I think my estimate of twenty per cent. was too high. We never considered that there was any advantage in the purchase of old wheels. I think twenty per cent. is too much. I don't think that ten per cent., in all cases, would cover the loss. Upon careful reflection I make the estimate twelve and a half per cent.

Ques. 3. Have you any explanation to make respecting your tes-
464 timony about the three hundred and four railroad cars furnished by Mr. Mowry to the Government, and the wheels with which those cars were furnished? If so, please make it.

Ans. The cars contained eight wheels each, double-and-single plate, and single-plate wheels. The number of each I am unable to give, even approximately. I see that I am recorded as stating that they were all thirty-three-inch single-plate wheels. I was misunderstood, or I said what I did not intend to say, and hence I make this correction.

Ques. 4. State, if you can, what proportion of the total number of annealed wheels made by Mr. Mowry were single-plate wheels?

Ans. I think about one sixth; I cannot state with certainty, but that is as nearly as I can state it.

SAMUEL FIRST.

465 *Statement of old car wheels used by A. L. Mowry.*

1861.					
April 27	Bo't of Cin'ti Street R'r'd	10 old street-car wheels	2013 lb.	*a* 1c.	$20 13
May 31	" Cin'ti Street R'r Co	10 old street-car wheels	1820 lb.	*a* 1c.	18 20
June 19	" Pen. & 5th Street R. R. Co	8 old street-car do.	1450 lb.	1c.	14 50
" "	" Passenger St. R. R. Co	3 old street-car w'ls	646 lb.	*a* 1c.	6 46
" "	" do "	4 27-in. old wheels	674	1c.	6 74
" "	" Cin'ti Street R'r'd	4 old wheels	777 lb.	*a* 1c.	7 77
July 3	" Passenger Street R. R	8 27-in. old wheels	1335 lb.	1c.	13 35
" "	" Cin'ti, Hamilton & D. R'r'd	Lot of old wheels	14621 lb.	1c.	146 21
" 13	" Passenger Street R'r'd	4 27-in. old wheels	692 lb.	*a* 1c.	6 92
August 17	" Passenger Street R'r'd Co	1 old wheel	220 lb.	*a* 1c.	2 20
Septem. 9	" Passenger Street " "	8 old wheels	1370 lb.	*a* 1c.	13 70
" "	" Cin'ti Street R'r'd	4 30-in. old wheels	732 lb.	1c.	7 32
October 2	" Passenger Street R'r'd	12 old wheels	2055 lb.	*a* 1c.	20 55
Novem. 20	" City Passenger R'r'd	8 old wheels	1425	*a* 1c.	14 25
December 19	" Cin'ti Street R'r'd	6 old wheels	1130 lb.	1c.	11 30
" 31	" L. & C. R'r'd	Old castings	36800 lb.	1c.	368 00
1862.					
January 9	" Passenger Street R'r'd	4 27-in. old wheels	1130 lb.	1c.	11 30
" 28	" Passenger Street R'r'd	8 30-in. old wheels	1680 lb.	1c.	16 80
February 11	" City Passenger St. R'r'd	4 30-in. old wheels	827 lb.	1c.	8 27
" 24	" City Pass. do	4 old wheels	828 lb.	*a* 1c.	8 28
March 11	" do. " "	4 old wheels	851 lb.	*a* 1c.	8 51
April 18	" do. " "	6 old wheels	1298	1c.	12 98
June 21	" Pendleton Street R'r'd	Lot of old castings	1692	1c.	16 92
July 25	" Cin'ti Street R. R. Co	" "	1023	1c.	10 23
August 4	" Spring Grove Av. R. R	4 old wheels	780 lb.	1c.	7 80
Septem. 25	" Pendleton Street R'r'd	4 old wheels	716 lb.	1¼c	8 95
October 27	" City Passenger St. R'r'd	4 old wheels	830 lb.	1¼c.	10 37
" 30	" L. M. & C. & X. R'r'd Co	63 old wheels	33493 lb.	*a* 1 1-5	401 91
Novem. 28	" City Passenger R'r'd	4 old wheels	845 lb.	1¼	10 56
December 16	" Cin'ti, Hamilton & Dayton R'r'd	111 old wheels	527	1¼c.	791 24
" 17	" L. & C. R'r'd Co	Old wheels	32549 26	1¼	407 02
1863.					
January 5	" City Passenger St. R'r'd	4 old wheels	854	1¼	10 68
" 21	" C., H. & D. R'r'd Co	Old wheels	4014	1c.	40 14
February 14	" Pendleton Street R'r'd	8 old wheels	750 lb.	1¼c.	9 37
" 26	" City Passenger St. R'r'd	8 old wheels	1620	1¼	20 25
March 4	" Cin'ti Street R'r'd	6 old wheels	1172	1¼	17 58
" 13	" City Passenger St. R'r'd	8 old wheels	1565	1¼	23 47
" "	" City Passeng	2 old wheels	400	1¼	6 00
" 31	" Pendleton & 5th St. R'r'd	2 old wheels	358	1¼	5 37
April 2	" City Passeng	2 do. "	390	1¼	5 85
May 6	" Cin'ti Street R'r'd	2 do. "	349	1¼	5 23
" 21	" do. "	2 do. "	403	1¼	6 05
" 26	" Pendleton Street R'r'd	2 do. "	340	1¼	5 10
June 16	" W. T. Nichols	13 steam-car wheels	5847	1¼	87 70
" 25	" City Passenger R'r'd	10 old street-car wheels	2251	1¼	33 76
" "	" Cin'ti Street R'r'd Co	11 old wheels	2284	1¼	34 26
July 11	" Cin'ti Street R'r'd Co	4 do	840	1¼c.	12 60
" 21	" Portsmouth & Newark R'r'd	4 30-in. do.	1860	1¼	27 90
" 24	" Fulton, Manufact. and Coal Min'g Co	1 30-in. do.	265	1¼	3 98
" 30	" Pendleton Street R'r'd	4 30-in. do.	759	1¼	11 38
August 10	" do. "	2 30-in. do.	344	1¼	5 16
" "	" Pendleton Street R'r'd	8 30-in. do.	1450	1¼	21 75
" 22	" do. "	2 30-in. do.	390	1¼	5 85
Septemb. 1	" City Passenger St. R'r'd	10 33-in. do.	1917	1¼	28 75
" 17	" Cin'ti Street R'r'd Co	8 30-in. do.	1500	1¼	22 50
" "	" City Passenger St. R'r'd	4 30-in. do.	790	1¼	11 85
October 16	" Cin'ti Street R'r'd Co	4 30-in. do.	740	1¼	11 10
November 2	" City Passenger St. R'r'd	17 " do.	3000	1¼	45 00
December 14	" Pendleton Street R'r'd	2 30-in. do.	330	1¼	4 95
466					
	Amount brought forward				$0,000 00
December 14	Bo't of City Passenger St. R'r'd	1 33-in. do.	215	*a* 1¼	3 22
" 16	" City Passenger St. R'r'd Co	6 33-in. old wheels	1080 lb.	*a* 1¼	16 20
" 17	" Fulton Manufac. and Coal M. Co	2 30-in. " "	520	*a* 1¼	7 82
" 18	" Pendleton Street R'r'd	4 30-in. " "	710	1¼	10 65
" 30	" Cin'ti Street R'r'd	6 33-in. " "	1188	1¼	17 82
1864.					
January 14	" Pendleton & 5th Street R'r'd	6 30-in. " "	1259	1¼	18 89
" "	" City Passenger Street	6 33-in. " "	1326	1¼	19 89
February 24	" Cin'ti, Hamilton & Dayton R'r'd Co	Old wheels	23500	2c.	470 00
" 23	" City Passenger R'r'd	22 old wheels	4426	2c.	88 52
March 24	" do. "	10 old wheels	2008	2c.	40 16
May 28	" City Passenger R'r'd	12 33-in. old wheels	2360	2c.	47 20
" "	" do. "	10 30-in. " "	1960	2c.	39 20
June 23	" do. "	4 33-in. " "	840	2c.	16 80
July 12	" Pendleton & 5th Street R'r'd	2 " " "	362	2c.	7 24
" 25	" City Pass. R'r'd Co	6 33-in. " "	1170	2c.	23 40

August 9	" do. "	21 " " "	4036	2c.	80	72
Septem. 28	" Pendleton & 5th St. R'r'd	5 30-in. " "	870	3c.	26	10
October 19	" City Passenger R'r'd	7 " " "	1374	3c.	41	22
" 21	" Pendleton & 5th St. R'r'd	2 " " "	394	3c.	11	82
Novemb. 14	" City Passenger R'r'd	11 " " "	2266	3c.	67	98
" 30	" L. M. & C. & X. R'r'd Co	Old wheels	60850 lb.	@ 3 1-10	2008	04
" "	" City Pass. R'r'd Co	9 33-in. " "	1800	3c.	54	00
December 15	" City Pass. R'r'd Co	5 33-in. "	1238	3c.	37	14
" 30	" Cin'ti, Hamilton & Dayton R'r'd Co	29 "	14092	1¾c.	246	61
1865.						
January 3	" City Pass. R'r'd Co	13 "	2522	3c.	75	66
February 24	" " " " "	45 "	6948	3	208	44
March 3	" Spring Grove Av. R'r'd	1 36-inch "	275	3c.	8	25
" 28	" City Pass. R'r'd Co	21 old wheels	4298	3c.	128	94
April 13	" do. " "	12 " "	2446	3c.	73	38
" 25	" do. " "	19 33-in. "	3984	3c.	119	52
March 9	" do. " "	10 33-in. "	2060	2c.	41	20
" 20	" do. " "	5 33-in. "	1022	2c.	20	44
" 26	" Cin'ti Street R'r'd	8 33-in. "	1660	2c.	33	20
May 30	" I. & C. R'r d Co	95 old wheels	45318	1¼c.	793	06
" "	" I. & C. do.	85 old wheels	40373	3¼c.	1312	12
" "	" do. "	37 do. "	18119	3c.	543	57
" "	" do. "	77 " "	36877	2½c.	921	92
" "	" " "	47½ " "	22062	2½c.	551	55
" "	" Ohio & Miss. R'r'd Co	38 " "	18997	3c.	569	91
" "	" do. "	9 chilled tires	7814	3c.	234	42
June 6	" City Pass. R'r'd Co	4 old wheels	860	2c.	17	20
" "	" Cin'ti Street R'r'd Co	4 " "	764	2c.	15	28
" 12	" Pendleton & 5th Street R'r'd Co	4 " "	690	2c.	13	80
July 24	" City Pass. R'r'd Co	6 " "	1174	1¾	20	52
August 4	" Chicago & Great East. R'r'd	213 old wheels	48 tons 164 lb.	a $30. 00	1442	20
Septem. 26	" Greenup Coal Co	4 " "	710 lb.	a 2c.	14	21
" "	" City Pass. R'r'd Co	10 33-in. "	2034	a 2c.	40	68
" "	" Cincinnati Street R'r'd	5 33-in. "	1314	2c.	26	28
October 27	" Cin'ti, Hamilton & Dayton R'r'd	75 old wheels	38140	1¾	667	45
" 28	" Cin'ti Street R'r'd Co	6 33-in. old wheels	1230	2c.	24	60
Novem. 22	" do. " "	7 " " "	1440	2c.	28	80
" "	" City Pass. St. R'r'd	14 " " "	2868	2c.	57	36
" 24	" Cin'ti Street R'r'd	6 33-in. " "	1270	2c.	25	40
" 30	" I. & C. R'r'd Co	55 old wheels	26333	2½c.	592	50
December 14	" Cin., Hamilton & Dayton R'r'd Co	77 old wheels	39900	2¼c.	897	75
" 30	" Eaton & Hamilton R'r'd Co	35 do.	16782	2¼c.	377	59
1866.						
January 31	" Cin'ti, Hamilton & Dayton R'r'd Co	113 do.	55750	2¼c.	1254	38
" "	" City Pass. R'r'd Co	5 33-in. "	1016	2c.	20	32
February 1	" Eaton & Hamilton R'r'd	40 old wheels	20236	2¼	455	31
467	Amount brought forward		00000		$0,000	00
March 16	Bo't of Cin'ti, Hamilton & Dayton R'r'd Co	40 33-in. "	24270	2¼	546	08
April 4	" Cin'ti, Hamilton & Dayton R'r'd Co	50½ " "	25140	2¼	565	65
" 28	" Cin'ti Street R'r'd	10 " "	2047	2c.	40	94
" "	" City Passenger R'r'd	10 do. "	2051	2c.	41	02
May 14	" Cin'ti Street R'r'd	8 old wheels	1516	a 2c.	30	12
" 21	" Passenger Street R'r'd	8 old "	1614	1¾	28	24
" 26	" Ohio & Miss. R'r'd Co	Old wheels	17250	2¼	388	13
June 9	" City Passenger St. R'r'd	8 " "	1632	1¾	28	56
" "	" Passenger Street R'r'd	8 " "	1628	1¾	28	49
" "	" Cin'ti Street R'r'd	2 " "	416	1¾	7	28
" 23	" " " "	2 " "	416	1¾	7	28
Jan'y 20	Austin Myers	162	74160	2	1483	20
" "	" "	308	154292	2	3085	84
July 26	Passenger S. R. Co	4	800	2	16	00
July 26	Cin. St. R. R. Co	4	798	2	15	96
Aug. 20	City Pass. St. R. R	12 33-in. old wheels	2448	2	48	96
"	Cin. St. R. R. Co	2 " "	416	2	8	32
Sept. 13	Cin., Ham. & D. R. R	50 " "	24240	2¼	515	10
" 21	City Pass. S. R. R	4 " "	816	2	16	32
"	Pass. St. R. R. Co	4 " "	816	2	16	32
Nov. 3	City Pass. R. R	12 " "	2496	2	49	92
" "	Pass. St. R. R	8	1664	2	33	28
30	Cin., Ham. & D. R. R	36	17262	2¼	374	55
"	" " "	4 old tires	2578	2¼	54	78
"	L. M. & C. & X. R. R	old wheels	106640	2¼	2666	00
1867.						
Feby. 6	C., H. & D. R. R. Co	180 " "	90277	2¼	2256	92
					$80313	45

This 28th day of July, 1868, came Samuel First, upon the requisition of the master, and testified as follows:

Question 1. Have you prepared the foregoing statement in accordance with my request, from the books of account of A. L. Mowry? If so, is it complete and correct, and what does it show?

Answer. I have so prepared it. It is a complete abstract from the books of A. L. Mowry—that is, from the day book—of all entries of old wheels purchased between the 1st of April, 1861, and the 12th of April, 1867, and used in the manufacture of car wheels. It includes, also, old tires purchased, and thus shows, so far as appears from Mr. Mowry's books, all the old iron purchased and used in the manufacture of car wheels, and the cost of the same. The books, however, do not show all the old wheels purchased, for the reason that sometimes Mr.
468 Mowry would settle with the parties from whom purchases were made, at his office, down in the city, and return to me only a statement of the amount to be credited to those parties.

Ques. 2. How much would it be right to allow for those settlements, at a liberal estimate?

Ans. Those settlements were all prior to 1864. Since the 1st of January, 1864, he has rendered to me full accounts, and the abstract shows the entire purchases. For the years 1861, 1862, and 1863, I should say there ought to be allowed six hundred wheels in addition to what is shown by the books, weighing, say one hundred and fifty tons. I would say one hundred wheels for 1861, two hundred for 1862, and three hundred for 1863; that is, twenty-five tons for 1861, fifty tons for 1862, and seventy-five tons for 1863—that, I think, will cover it.

Ques. 3. At what prices should these estimated purchases be computed?

Ans. At the same rates per pound as shown by the abstract for the same period.

Ques. 4. Was all this old iron used in the manufacture of annealed car wheels? if not, how much of it was used for other purposes?

Ans. As far as I know, it was all used for car wheels and chilled tires—the chilled tires amounting only to four or five tons per year, as I have before stated.

Ques. 5. What quantity of old wheels did you have on hand at the date of the injunction?

Ans. I think we had a few, but not many. I do not remember how many.

Ques. 6. Now, if we add to the cold-blast iron purchased and used for the manufacture of annealed car wheels, the old wheels and old
469 tires referred to in your testimony above, and the abstract, will that make up the total of iron used in the manufacture of annealed car wheels by Mr. Mowry?

Ans. Yes, sir; I think it will.

Ques. 7. Was any of this material used in the manufacture of unannealed car wheels? if so, how much, and when?

Ans. It was all used in the manufacture of annealed wheels, except the two lots of unannealed wheels sold to Mr. Wessel, August 22, 1863, and September 1, 1863, as heretofore stated by me.

Ques. 8. Did you use up during each year all the old wheels purchased in that year?

Ans. Never, except one year, when we cleaned them out within four or five. One year—I think, 1864—we had quite a number left over. The invoices show that we had each year old iron on hand, in which was included old wheels, but they were not designated as to quantity or weight.

SAMUEL FIRST.

470 *The findings of George R. Sage, master, &c., as to the numbers, sizes, and prices of annealed car wheels sold by A. L. Mowry, April, 1861, to April, 1867, as per sales books.*

1861.	33-inch.			30-inch.			28-inch.			26-inch.			24-inch.			33-inch street car.			30-inch street car.			Totals.	
Month.	No. sold.	Price.	Amount.	No. sold.	Price.	Amount.	No. sold.	Price.	Amount.	No. sold.	Price.	Amount.	No. sold.	Price.	Amount.	No. sold.	Price.	Amount.	No. sold.	Price.	Amount.	No. sold.	Amount.
April.	30	$14 00	$420 00	6	$13 00	$78 00	....	.....	.....	....	.....	.....	....	.....	.....	....	.....	.....	....	.....	.....	36	$498 00
May.	60	14 00	840 00	4	13 00	52 00	....	.....	.....	....	.....	.....	....	.....	.....	....	.....	.....	8	$8 00	$64 00	72	956 00
June.	25	14 00	350 00	56	13 00	728 00	....	.....	.....	16	$11 50	$184 00	....	.....	.....	....	.....	.....	20	8 00	160 00	117	1,422 00
July.	26	14 00	364 00	10	13 00	130 00	....	.....	.....	16	11 00	176 00	....	.....	.....	....	.....	.....	12	8 00	96 00	64	766 00
Aug.	138	13 50	1,863 00	22	13 00	286 00	....	.....	.....	2	11 00	22 00	....	.....	.....	4	$8 00	$32 00	....	.....	.....	166	2,203 00
Sept.	....	.....	.....	19	13 00	247 00	....	.....	.....	....	.....	.....	....	.....	.....	12	8 00	96 00	....	.....	.....	31	343 00
Oct.	14	13 00	182 00	19	12 00	228 00	....	.....	.....	32	10 00	320 00	....	.....	.....	8	8 00	64 00	....	.....	.....	73	794 00
Nov.	{ 22	13 00	286 00 }	43	12 00	516 00	....	.....	.....	....	.....	.....	....	.....	.....	8	8 00	64 00	....	.....	.....	103	1,271 00
	{ 30	13 50	405 00 }																				
Dec.	{ 32	13 00	416 00 }	4	12 00	48 00	....	.....	.....	....	.....	.....	....	.....	.....	....	.....	.....	6	8 00	48 00	62	782 00
	{ 20	13 50	270 00 }																				
Total.	397	.....	$5,396 00	183	.....	$2,313 00	....	.....	.....	66	.....	$702 00	....	.....	.....	32	.....	$256 00	46	.....	$368 00	724	$9,035 00

1862.	33-inch.			30-inch.			28-inch.			26-inch.			24-inch.			33-inch street car.			30-inch street car.			Totals.	
Month.	No. sold.	Price.	Amount.	No. sold.	Price.	Amount.	No. sold.	Price.	Amount.	No. sold.	Price.	Amount.	No. sold.	Price.	Amount.	No. sold.	Price.	Amount.	No. sold.	Price.	Amount.	No. sold.	Amount.
Jan.	132	$13 00	$1,716 00	....	.....	.....	....	.....	.....	....	.....	.....	....	.....	.....	14	$8 00	$112 00	....	.....	.....	146	$1,828 00
Feb.	121	13 00	1,573 00	86	12 00	$1,032 00	....	.....	.....	....	.....	.....	....	.....	.....	8	8 00	64 00	....	.....	.....	215	2,669 00
Mar.	192	13 00	2,496 00	20	12 00	240 00	....	.....	.....	....	.....	.....	....	.....	.....	4	8 00	32 00	....	.....	.....	216	2,768 00
April.	91	13 00	1,183 00	20	12 00	240 00	....	.....	.....	....	.....	.....	....	.....	.....	6	8 00	48 00	....	.....	.....	117	1,471 00
May.	10	13 00	130 00	12	12 00	144 00	2	11 50	$23 00	....	.....	.....	....	.....	.....	6	8 00	48 00	....	.....	.....	30	345 00
June.	160	13 00	2,080 00	14	12 00	168 00	10	11 50	115 00	....	.....	.....	....	.....	.....	....	.....	.....	6	8 00	$48 00	190	2,411 00
July.	16	13 00	208 00	28	12 00	336 00	....	.....	.....	....	.....	.....	....	.....	.....	10	8 00	80 00	....	.....	.....	54	624 00
Aug.	....	.....	.....	....	.....	.....	....	.....	.....	....	.....	.....	....	.....	.....	4	8 00	32 00	....	.....	.....	4	32 00
Sept.	17	15 00	255 00	10	14 00	140 00	....	.....	.....	....	.....	.....	....	.....	.....	....	.....	.....	4	7 50	30 00	31	425 00
Oct.	356	15 00	5,340 00	40	14 00	560 00	....	.....	.....	....	.....	.....	....	.....	.....	12	8 00	96 00	....	.....	.....	408	5,996 00
Nov.	114	15 00	1,710 00	20	14 00	280 00	....	.....	.....	....	.....	.....	....	.....	.....	4	8 00	32 00	....	.....	.....	138	2,022 00
Dec.	18	15 00	270 00	....	.....	.....	....	.....	.....	....	.....	.....	....	.....	.....	8	8 00	64 00	....	.....	.....	26	334 00
Total.	1,227	.....	$ 6,961 00	250	.....	$3 140 00	12	.....	138 00	....	.....	.....	....	.....	.....	76	.....	$608 00	10	.....	$78 00	1,575	$20,925 00

1863.	33-inch.			30-inch.			28-inch.			26-inch.			24-inch.			33-inch street car.			30-inch street car.				
Month.	No. sold.	Price.	Amount.	No. sold.	Price.	Amount.	No. sold.	Price.	Amount.	No. sold.	Price.	Amount.	No. sold.	Price.	Amount.	No. sold.	Price.	Amount.	No. sold.	Price.	Amount.	No. sold.	Amount.
Jan.	40	$15 00	$600 00	4	$14 00	$56 00	4	$11 50	$46 00	....	.....	.....	....	.....	.....	4	$8 00	$32 00	....	.....	.....	52	$734 00
Feb.	96	15 00	1,440 00	82	14 00	1,148 00	....	.....	.....	....	.....	.....	....	.....	.....	....	.....	.....	8	7 50	60 00	186	2,648 00
Mar.	430	16 00	6,880 00	....	.....	.....	....	.....	.....	....	.....	.....	....	.....	.....	....	.....	.....	....	.....	.....	430	6,880 00
April.	170	16 00	2,720 00	10	15 00	150 00	....	.....	.....	....	.....	.....	....	.....	.....	8	8 50	68 00	....	.....	.....	188	2,938 00
May.	162	16 00	2,592 00	....	.....	.....	....	.....	.....	....	.....	.....	....	.....	.....	24	8 50	204 00	16	8 00	128 00	178	2,720 00
June.	204	16 00	3,366 00	..	.....	.....	....	.....	.....	....	.....	.....	....	.....	.....	....	.....	.....	....	.....	.....	228	3,570 00
July.	160	16 00	2,640 00	....	.....	.....	....	.....	.....	....	.....	.....	....	.....	.....	....	.....	.....	....	.....	.....	160	2,640 00
Aug.	160	16 00	2,560 00	....	.....	.....	4	14 50	58 00	....	.....	.....	....	.....	.....	....	.....	.....	8	8 00	64 00	172	2,682 00
Sept.	645	16 00	10,320 00	32	15 00	480 00	....	.....	.....	....	.....	.....	....	.....	.....	25	8 50	212 50	....	.....	.....	702	11,012 50
Oct.	124	16 00	1,984 00	....	.....	.....	....	.....	.....	....	.....	.....	....	.....	.....	8	8 50	68 00	....	.....	.....	132	2,052 00
Nov.	292	16 00	4,672 00	....	.....	.....	....	.....	.....	....	.....	.....	....	.....	.....	....	.....	.....	....	.....	.....	292	4,672 00
Dec.	705	16 00	11,280 00	2	12 50	25 00	....	.....	.....	....	.....	.....	....	.....	.....	15	9 00	135 00	....	.....	.....	722	11,440 00
Total.	3,188	.....	$51 054 00	130	.....	$1,859 00	8	.....	$104 00	....	.....	.....	....	.....	.....	84	.....	$719 50	32	.....	$252 00	3,442	$53,988 50

1864.	33-inch.			30-inch.			28-inch.			26-inch.			24-inch.			33-inch street car.			30-inch street car.			Totals.	
Month.	No. sold.	Price.	Amount.	No. sold.	Price.	Amount.	No. sold.	Price.	Amount.	No. sold.	Price.	Amount.	No. sold.	Price.	Amount.	No. sold.	Price.	Amount.	No. sold.	Price.	Amount.	No. sold.	Amount.
Jan.	341	$19 00	$6,479 00	48	$18 00	$864 00	....	.....	.....	....	.....	.....	....	.....	.....	....	.....	.....	28	$10 00	$280 00	417	$7,623 00
Feb.	260	20 50	5,330 00	36	19 00	684 00	....	.....	.....	....	.....	.....	....	.....	.....	....	.....	.....	27	10 00	270 00	323	6,284 00
Mar.	498	20 00	9,960 00	10	21 50	215 00	....	.....	.....	4	$16 00	$64 00	....	.....	.....	15	$10 00	$150 00	....	.....	.....	527	10,389 00
April.	410	22 00	9,020 00	8	21 00	168 00	....	.....	.....	....	.....	.....	....	.....	.....	....	.....	.....	6	10 00	60 00	424	9,248 00
May.	548	24 75	13,563 00	20	23 00	460 00	....	.....	.....	4	15 50	62 00	....	.....	.....	16	11 00	176 00	....	.....	.....	588	14,261 00
June.	369	24 50	9,040 50	36	23 00	828 00	....	.....	.....	2	19 00	38 00	37	$18 00	$666 00	....	.....	.....	....	.....	.....	444	10,572 50
July.	609	24 50	14,920 50	34	23 00	782 00	....	.....	.....	....	.....	.....	181	18 00	3,258 00	14	12 00	168 00	....	.....	.....	838	19,128 50
Aug.	218	30 00	6,540 00	14	27 00	378 00	....	.....	.....	8	15 00	120 00	196	18 00	3,528 00	24	13 00	312 00	....	.....	.....	460	10,878 00
Sept.	408	30 00	12,240 00	....	.....	.....	....	.....	.....	....	.....	.....	106	18 00	1,908 00	27	13 00	351 00	....	.....	.....	541	14,499 00
Oct.	274	31 00	8,494 00	66	29 00	1,914 00	....	.....	.....	....	.....	.....	....	.....	.....	18	15 00	270 00	....	.....	.....	358	10,678 00
Nov.	255	31 00	7,905 00	....	.....	.....	....	.....	.....	....	.....	.....	....	.....	.....	10	15 00	150 00	....	.....	.....	265	8,055 00
Dec.	993	31 00	30,783 00	....	.....	.....	....	.....	.....	....	.....	.....	....	.....	.....	25	15 00	375 00	....	.....	.....	1,018	31,158 00
Total.	5,183	.....	$134,275 00	272	.....	$6,293 00	....	.....	.....	18	.....	$284 00	520	.....	$9,360 00	149	.....	$1,952 00	61	.....	$610 00	6,203	$152,774 00

1865.	33-inch.			30-inch.			28-inch.			26-inch.			24-inch.			33-inch street car.			30-inch street car.			Totals.	
Month.	No. sold.	Price.	Amount.	No. sold.	Price.	Amount.	No. sold.	Price.	Amount.	No. sold.	Price.	Amount.	No. sold.	Price.	Amount.	No. sold.	Price.	Amount.	No. sold.	Price.	Amount.	No.	Amount.
Jan..	225	$31 00	$6,975 00	80	$30 00	$2,400 00	....	.....	.....	....	.....	.....	....	.....	.....	8	$15 00	$120 00	....	.....	.....	313	$9,495 00
Feb..	90	30 00	2,700 00	....	.....	.....	....	.....	.....	....	.....	.....	4	$15 00	$60 00	29	15 00	435 00	....	.....	.....	123	3,195 00
Mar..	100	30 00	3,000 00	....	.....	.....	....	.....	.....	....	.....	.....	....	.....	.....	19	15 00	285 00	....	.....	.....	119	3,285 00
April	143	28 00	4,004 00	8	26 00	208 00	....	.....	.....	....	.....	.....	....	.....	.....	36	15 00	540 00	....	.....	.....	187	4,752 00
May .	117	28 00	3,276 00	12	27 00	324 00	....	.....	.....	....	.....	.....	....	.....	.....	....	.....	.....	48	$14 00	$672 00	177	4,272 00
June	150	26 00	3,900 00	40	25 00	1,000 00	....	.....	.....	....	.....	.....	....	.....	.....	....	.....	.....	11	14 00	154 00	201	5,054 00
July .	322	26 00	8,372 00	83	24 00	1,992 00	....	.....	.....	....	.....	.....	....	.....	.....	....	.....	.....	25	13 00	325 00	430	10,689 00
Aug .	50	24 00	1,200 00	67	23 00	1,541 00	18	$22 00	$396 00	....	.....	.....	....	.....	.....	....	.....	.....	7	13 00	91 00	142	3,228 00
Sept .	160	24 00	3,840 00	63	23 00	1,449 00	16	22 00	352 00	12	$22 00	264 00	....	.....	.....	....	.....	.....	10	13 00	130 00	261	6,035 00
Oct ..	86	24 00	2,064 00	109	23 00	2,507 00	8	23 00	184 00	16 15	15 00 22 00	240 00 330 00	8	20 00	160 00	....	.....	.....	....	.....	.....	242	5,485 00
Nov..	446	24 00	10,704 00	70	24 00	1,680 00	16	23 00	368 00	13	22 00	286 00	....	.....	.....	25	14 00	350 00	....	.....	.....	570	13,388 00
Dec..	646	25 00	16,150 00	51	24 00	1,224 00	....	.....	.....	8	22 00	176 00	....	.....	.....	34	14 00	476 00	....	.....	.....	739	18,026 00
Total.	2,535	.....	$66,185 00	583	.....	$14,325 00	58	.....	$1,300 00	64	.....	$1,296 00	12	.....	$220 00	151	.....	$2,206 00	101	.....	$1,372 00	3,504	$86,904 00

1866.	33-inch.			30-inch.			28-inch.			26-inch.			24-inch.			33-inch street car.			30-inch street car.			Totals.	
Month.	No. sold.	Price.	Amount.	No. sold.	Price.	Amount.	No. sold.	Price.	Amount.	No. sold.	Price.	Amount.	No. sold.	Price.	Amount.	No. sold.	Price.	Amount.	No. sold.	Price.	Amount.	No. sold.	Amount.
Jan..	243	$25 00	$6,075 00	142	$24 00	$3,408 00	26	$24 00	$624 00	6	22 00	$132 00	....	.....	.....	4	$14 00	$56 00	....	.....	.....	421	$10,295 00
Feb..	83	25 00	2,075 00	76	24 00	1,824 00	16	24 00	384 00	12	22 00	264 00	....	.....	.....	20	14 00	280 00	....	.....	.....	207	4,827 00
Mar..	200	24 00	4,800 00	....	.....	.....	12	23 00	276 00	4	22 00	88 00	....	.....	.....	12	13 00	156 00	....	.....	.....	228	5,320 00
April	25	24 00	600 00	12	22 00	264 00	....	.....	.....	....	.....	.....	4	$14 00	$56 00	26	13 00	338 00	....	.....	.....	67	1,258 00
May	80	23 00	1,840 00	32	21 00	672 00	....	.....	.....	200	15 00	3,000 00	....	.....	.....	14	12 00	168 00	....	.....	.....	326	5,680 00
June	58	23 00	1,334 00	16	21 00	336 00	8	20 00	160 00	....	.....	.....	8	16 00	128 00	15	12 00	180 00	....	.....	.....	105	2,138 00
July	55	22 00	1,210 00	14	21 00	294 00	4	19 00	76 00	96	15 00	1,440 00	....	.....	.....	12	12 00	144 00	....	.....	.....	181	3,164 00
Aug	81	21 00	1,701 00	12	21 00	252 00	4	20 00	80 00	104	15 00	1,560 00	....	.....	.....	18	12 00	216 00	....	.....	.....	219	3,809 00
Sept	293	22 00	6,446 00	20	21 00	420 00	24	20 00	480 00	148	15 00	2,220 00	....	.....	.....	10	12 00	120 00	....	.....	.....	495	9,686 00
Oct ..	439	21 00	9,219 00	32	21 00	672 00	12	20 00	240 00	48	15 00	720 00	....	.....	.....	12	12 00	144 00	....	.....	.....	543	10,995 00
Nov..	256	21 00	5,376 00	4	21 00	84 00	....	.....	.....	....	.....	.....	24	17 00	408 00	32	12 00	384 00	....	.....	.....	316	6,252 00
Dec..	430	21 00	9,030 00	....	.....	.....	12	20 00	240 00	8	17 00	136 00	....	.....	.....	6	12 00	72 00	....	.....	.....	556	9,478 00
Total.	2,243	.....	$49,706 00	360	.....	$8,226 00	118	.....	$2,560 00	626	.....	$9,560 00	36	.....	$592 00	181	.....	$2,258 00	....	.....	.....	3,564	$72,902 00

1867.	33-inch.			30-inch.			28-inch.			26-inch.			24-inch.			33 inch street car.			30-inch street car.			Totals.	
Month.	No. sold.	Price.	Amount.	No. sold.	Price.	Amount.	No. sold.	Price.	Amount.	No. sold.	Price.	Amount.	No. sold.	Price.	Amount.	No. sold.	Price.	Amount.	No. sold.	Price.	Amount.	No. sold.	Amount.
Jan	224	$21 75	$4,872 00	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	8	$12 00	$96 00	.....	.....	.....	232	$4,968 00
Feb	136	21 00	2,856 00	21	$20 00	$420 00	.....	.....	.....	.....	.....	.....	.....	.....	.....	22	12 00	264 00	.....	.....	.....	179	3,540 00
Mar	312	21 00	6,552 00	10	20 00	200 00	7	$20 00	$140 00	.....	.....	.....	.....	.....	.....	27	12 00	324 00	.....	.....	.....	356	7,216 00
	672	.....	14,280 00	31	.....	620 00	7	20 00	140 00	.....	.....	.....	.....	.....	.....	57	.....	684 00	.....	.....	.....	757	15,724 00
April, 1867, on hand	286	21 00	6,006 00	90	20 00	1,800 00	15	20 00	300 00	26	15 00	390 00	.....	.....	.....	6	12 00	72 00	.....	.....	.....	423	8,568 00
Totals	958	.....	$20,286 00	121	.....	$2,420 00	22	.....	$440 00	26	.....	$390 00	.....	.....	.....	63	.....	$756 00	.....	.....	.....	1,190	$24,292 00

RECAPITULATION.

	1861.	1862.	1863.	1864.	1865.	1866.	1867. Sold.	1867. On hand.	1867. Totals.	Aggregate.
33-inch	397	1,227	3,188	5,183	2,535	2,243	672	286	958	15,731
30 "	183	250	130	272	583	360	31	90	121	1,899
28 "	.....	12	8	.....	58	118	7	15	22	218
26 "	66	.....	.....	18	64	626	.....	26	26	800
24 "	.....	.....	.....	520	12	36	.....	.....	.....	568
33 " street car	32	76	84	149	151	181	57	6	63	736
30 " " "	46	10	32	61	101	.....	.....	.....	.....	250
Totals	724	1,575	3,442	6,203	3,504	3,564	767	423	1,190	20,202

	1861.	1862.	1863.	1864.	1865.	1866.	1867. Proceeds of sales.	1867. Value of wheels on hand.	1867. Total.	Aggregate.
Amount of sales	$9,035 00	$20,925 00	$53,988 50	$152,774 00	$86,904 00	$72,902 00	$15,724 00	$8,568 00	$24,292 00	$420,820 50

474 SCHEDULE A.—*Number, sizes, and estimated average, and aggregate weights of wheels made.*

Sizes.*	33-inch.	30-inch.	28-inch.	26-inch.	24-inch.	Street car. 33-inch.	Street car. 30-inch.	Totals.	Aggregate weight in lbs.	Weight in tons of 2,268 lbs.
Average weights....	505 lbs.	476 lbs.	396 lbs.	324 lbs.	300 lbs.	208 lbs.	204 lbs.			
Sold in 1861.‡.....	397	183	"	66	"	32	46	724	"	"
On hand Jan. 1, '62.‖	137	127	17	11	"	28	14	334	"	"
Made in 1861	534	310	17	77	"	60	60	1,058	"	"
Aggregate weight... 1861.	269, 670	147, 560	6, 562	24, 948	"	12, 480	12, 240	"	437, 460	208. 171
Sold in 1862.‡.....	1, 227	250	12	"	"	76	10	1, 575	"	"
On hand Jan. 1, '63.‖	258	63	5	11	"	24	9	370	"	"
Totals.....	1, 485	313	17	11	"	100	19	1, 945	"	"
On hand Jan. 1, '62..	137	127	17	11	"	28	14	334	"	"
Made in 1862.....	1, 348	186	"	"	"	72	5	1, 611	"	"
Aggregate weight... 1862.	680, 740	88, 536	"	"	"	14, 976	1, 020	"	785, 272	346. 54
475 Sold in 1863.‡.	3, 188	130	8	"	"	84	32	3, 442	"	"
On hand Jan. 1, '64.‖	312	62	4	11	4	2	10	405	"	"
Totals.....	3, 500	192	12	11	4	86	42	3, 847	"	"
On hand Jan. 1, '63..	258	63	5	11	"	24	9	370	"	"
Made in 1863.....	3, 242	129	7	"	4	62	33	3, 477	"	"
Aggregate weight... 1863.	1, 637, 210	61, 404	2, 702	"	1, 200	12, 896	6, 732	"	1, 722, 144	759. 732
Sold in 1864.‡.....	5, 183	272	**4	18	520	149	61	6, 207	"	"
On hand Jan. 1, '65.‖	726	74	"	8	1[illegible]	32	9	860	"	"
Totals.....	5, 909	346	4	26	531	181	70	7, 067	"	"
On hand Jan. 1, '64..	312	62	4	11	4	2	10	405	"	"
Made in 1864.....	5, 597	135, 184	"	15	527	179	60	6, 662	"	"
Aggregate weight... 1864.	2, 826, 485	135, 184	"	4, 860	158, 100	37, 232	12, 240	"	3, 174, 101	1, 399. 1169
476 Sold in 1865.‡	2, 535	583	58	64	12	151	101	3, 504	"	"
On hand Jan. 1, '66.‖	130	33	31	14	20	21	"	249	"	"
Totals.....	2, 665	616	89	78	32	172	101	3, 753	"	"
On hand Jan. 1, '65..	726	74	"	8	11	32	9	860	"	"
Made in 1865.....	1, 939	542	89	70	21	140	92	2, 893	"	"
Aggregate weight... 1865.	979, 195	257, 992	34, 354	22, 680	6, 300	29, 120	18, 768	"	1, 348, 409	594. 1217
Sold in 1866.‡.....	2, 243	360	118	626	36	181	"	3, 564	"	
On hand Jan. 1, '67.‖	540	89	11	55	7	27	6	735	"	
Totals.....	2, 783	449	129	681	43	208	6	4, 299	"	
On hand Jan. 1, '66..	130	33	31	14	20	21	"	249	"	
Made in 1866.....	2, 653	416	98	667	23	187	6	4, 050	"	
Aggregate weight... 1866.	1, 339, 765	198, 016	37, 828	216, 108	6, 900	38, 896	1, 224	"	1, 838, 737	810. 1657

Schedule A—Continued.

477	Sold in 1867.†	672	31	7	††29	‡‡7	57	"	803	
	On hand Ap'l 11, '67.§	286	90	15	26	,,	6	"	423	
	Totals	958	121	22	55	7	63	"	1,226	
	On hand Jan. 1, '67.‖	540	89	11	55	7	33	"	375	
	Made in 1867	418	32	11	"	,,	30	"	491	
	Aggregate weight... 1867.	211,090	15,232	4,246	"	"	6,240	"	"	236,808	104.936

RECAPITULATION.

Years.	No. of wheels made.	Weight.	
		Pounds.	Tons.
1861	1,058	473,460	208.1716
1862	1,611	785,272	346. 544
1863	3,477	1,722,144	759. 732
1864	6,662	3,174,101	1,399.1169
1865	2,893	1,348,409	594.1217
866	4,050	1,838 737	810.1657
867	491	236,808	104. 936
	20,242	9,578,931	4,223.1167

*Deposition of A. L. Mowry, page 28, question 7.
†Exhibit A. L. Mowry, 1, page 33.
‡By defendant's books, as per master's findings.
‖Samuel First's tables, page 7.
§Samuel First, page 15.
**These wheels do not appear in the findings from the sales-book, but being invoiced as on hand January 1, 1864, and not appearing in the invoice of 1865, they must have been sold in 1865, and are charged accordingly.
††These were invoiced on hand January 1, 1867, and do not appear on hand in April, 1867; they must, therefore, be charged as sold.
‡‡The same rule applies to these as in ††

478 SCHEDULE B.—*Purchases, prices, and average and aggregate cost of iron per Exhibit L. A. Green & Co., p. 72, and Samuel First's table and testimony of old wheels purchased.*

Years.	Month.	Tons of iron purchased.		Price per ton.	Total cost.	Av'ge cost.
		Tons.	*Lbs.*			
1861....	Aug. 5	22	"	23 00	506 00	1861. $24 24 per ton.
"	" "	7	44	25 00	175 49	
"	" 8	4	1,080	25 00	117 90	
"	Nov. 21	12	465	23 00	280 71	
"	Oct. 27	2	1,134	25 00	62 50	
"	May 13	15	1,690	26 00	409 38	
"	Dec. 5	9	760	24 00	224 04	
Total.	"	73	637	"	$1,776 02	
1862....	April 4	100	50	27 00	2,700 50	1862. $30 36 per ton.
"	30	100	1,574	27 00	2,718 73	
"	May 17	8	"	25 80	206 40	
"	Nov. 15	94	2,130	38 00	3,607 69	
"	Aug. 15	40	"	30 00	1,200 00	
Total.	"	343	1,486	"	$10,433 32	
1863....	March 9	193	944	45 00	8,703 73	1863. $46 24 per ton.
"	June 15	101	1,772	40 00	4,071 25	
"	Sept. 23	111	2,008	45 00	5,034 84	
"	Dec. 4	115	1,475	55 00	6,360 77	
Total.	"	522	1,663	"	$24,170 59	

Schedule B—Continued.

Years.	Month.	Tons of iron purchased.		Price per ton.	Total cost.	Av'ge cost.
						1864.
1864	Jan. 7	91	1,832	49 00	4,498 58	$69 69½ per ton.
"	Feb. 5	98	2,088	65 00	6,429 84	
"	June 23	206	1,020	65 00	13,419 23	
"	March 14	150	"	60 00	9,000 00	
"	"	7	1,107	65 00	486 28	
"	Sept. 26	57	"	70 00	3,990 00	
"	Aug. 29	10	905	85 00	883 90	
"	July 28	5	"	80 00	400 00	
"	Aug. 24	5	314	83 00	426 49	
"	Sept. 9	102	218	77 50	7,912 45	
"	"	107	"	79 50	8,506 50	
"	Dec. 1	35	"	80 00	2,800 00	
"	Nov. 29	150	"	75 00	11,250 00	
"	"	50	"	80 00	4,000 00	
"	"	100	"	73 00	7,300 00	
"	"	50	"	73 00	3,650 00	
"	"	50	"	80 00	4,000 00	
Total	"	1,276	680	"	$88,953 27	
						1865.
1865	November 13	26	820	$65 00	$1,713 50	$66 31.
"	" 23	4	"	62 00	248 00	
"	July 28	21	182	54 00	1,138 33	
"	June 23	48	1,914	55 00	2,685 42	
"	September 25	25	"	65 00	1,625 00	
"	October 3	20	1,656	65 00	1,347 46	
"	December 9	22	1,776	62 00	1,412 55	
"	April 4	99	1,794	80 00	7,983 28	
"	July 6	5	1,524	50 00	283 60	
"	December 20	59	1,134	60 00	3,570 00	
"	"	17	1,005	70 00	1,221 00	
"	"	4	2,042	70 00	343 02	
"	"	11	419	70 00	782 93	
Total		367	658	.....	$24,355 09	
						1866.
1866	January 15	69	1,456	$62 50	$4,352 62	$62 33.
"	February 14	5	"	75 00	375 00	
"	May 28	50	"	55 00	2,755 00	
"	September 14	4	"	67 50	270 00	
"	" 12	5	"	67 50	337 50	
"	" 10	5	"	67 50	337 50	
"	" 3	10	364	67 50	685 83	
"	" 1	10	"	67 50	675 00	
"	" 22	2	"	67 50	135 00	
"	October 2	97	1,879	65 00	6,358 85	
"	" 24	5	"	65 00	325 00	
"	November 7	2	230	60 00	126 09	
"	December 20	265	1,232	61 50	12,650 91	
Total	"	471	625	.....	$29,374 30	

Recapitulation of Exhibit L. A. Green & Co., p. 72.

Years.	Tons bought.		Average price.	Total cost.	
	Tons.	*Lbs.*			
1861	73	637	$24 24	$1,776 02	Average cost, $58 63 1-5.
1862	343	1,486	30 36	10,433 32	
1863	522	1,663	46 24	24,170 59	
1864	1,276	680	69 69½	88,953 27	
1865	367	658	66 31	24,355 09	
1866	471	625	62 33	29,374 30	
1867	"	"	"	"	
Total	3,054	1,213	58 63 1-5	$179,062 59	

Recapitulation of Samuel First's tables and estimate of old wheels and tires purchased.

Aggregate annual purchases.				
Years.	Pounds.	Tons.	Average cost.	Total cost.
1861	67,760	29.1988	22 68	$677 60
"	56,700	25. " *	22 68	567 00
1862	131,304	57.9028	29 90	1,731 14
"	113,400	50. " *	29 90	1,495 00
1863	40,495	17.1939	32 44	579 29
"	170,100	75. " *	32 44	2,433 00
1864	126,131	55.1391	60 14	3,344 93
1865	459,312	202.1176	48 87	9,897 22
1866	544,408	240. 88	49 27	11,826 35
1867	90,277	39.1825	56 70	2,256 92
Total	1,799,887	793.1363	" "	$34,808 45

*Estimated by First.

Summary.

Total iron.	Amount.		Cost.
	Tons.	*Lbs.*	
On hand Jan. 1, 1861	266	1,134	$6,459 99
New iron purchased	3,054	1,213	172,062 55
Old wheels purchased	793	1,363	34,808 46
Aggregate	4,114	1,442	$220,331 00

479 SCHEDULE C.—*Cost of iron for annealed wheels each year.*

	Tons. Lbs.	Cost.	Amount.	Tons. Lbs.	Cost per ton.	Total cost.
1861.						
A. L. Mowry had on hand January 1, 1861				266 1,134	$24 24	$6,459 96
Bought during 1861				73 637	24 24	1,776 02
" " " old wheels				54 1,988	22 68	1,244 60
Showing total iron				394 1,491	" "	9,480 58
From which is to be deducted:						
Iron on hand January 1, 1862	100 "	$24 24	$2,424 00			
Estimated as used for tires	5 "	24 24	121 20	105 "	24 24	2,545 20
Leaving as amount used in 1861				289 1,491	" "	6,935 38
1,058 wheels, weighing	208 1,716				22 24	5,480 25
To which add, for loss in casting, 10 per cent.	20 1,986			229 1,434	22 68	
Remaining to represent unannealed wheels made before April 1861				60 57	" "	1,455 13

480 *Schedule C*—Continued.

	Tons. Lbs.	Cost.	Amount.	Tons. Lbs.	Cost per ton.	Total cost.
1862.						
A. L. Mowry had on hand January 1, 1862				100 "	24 24	$2,424 00
Bought during 1862				343 1,486	30 36	10,433 32
" " " old wheels				107 2,028	29 90	3,226 14
Showing total iron				551 1,246	" "	16,083 46
From which is to be deducted:						
Iron on hand January 1, 1863	152 "	$30 36	4,614 72			
Estimated as used for tires	5 "	30 36	151 80	157 "	" "	4,766 52
Leaving as amount used in 1862				394 1,246		11,316 94
1,611 wheels, weighing	346 544					
To which add, for loss in casting, 10 per cent.	34 1,415			380 1,959		
Remaining to represent underestimate of weights				13 1,555	" "	" "

481 *Schedule C*—Continued.

	Tons. Lbs.	Cost.	Amount.	Tons. Lbs.	Cost per ton.	Total cost.
1863.						
A. L. Mowry had on hand January 1, 1863				152 "	$30 36	$4,614 72
Bought during 1863				522 1,663	46 24	24,170 59
" " " old wheels				92 1,939	32 44	3,012 29
Showing total iron				767 1,334	" "	31,797 60
From which is to be deducted:						
Iron on hand January 1, 1864	130 "	$46 24	$6,011 20			
Estimated as used for tires	4 "	30 26	121 44			
For 100 30-inch truck wheels, sold Wessel, not annealed, say (100) 440 lbs. each=19.908 tons ×10 per cent.=1.2132 tons.	21 772	32 44	692 37	155 772	" "	6,825 01
Leaving as amount used in 1863				612 562	" "	24,972 59
3,477 wheels, weighing				759 732		
Excess over total iron, showing overestimate of weights				146 2,098	" "	" "

482 *Schedule C*—Continued.

	Tons. Lbs.	Cost.	Amount.	Tons. Lbs.	Cost per ton.	Total cost.
1864.						
A. L. Mowry had on hand January 1, 1864				130 "	$46 24	$6,011 20
Bought during 1864				1,276 680	69 69½	88,953 27
" " " old wheels				55 1,391	60 14	3,344 93
Showing total iron				1,461 2,071	" "	98,309 40
From which is to be deducted:						
Iron on hand January 1, 1865	355 1,134	$69 69½	$24,776 57			
Estimated as used for tires	4 "	60 14	244 56	359 1,134	" "	25,021 13
Leaving as amount used in 1864				1,102 937	" "	73,288 27
6,662 wheels, weighing				1,399 1,169	" "	" "
Excess over total iron, showing overestimate of weights				297 232	" "	" "

483 *Schedule C*—Continued.

	Tons.	Lbs.	Cost per ton.	Total cost.
1865.				
A. L. Mowry had on hand January 1, 1865	355	1,134	$69 62½	$24,776 57
Bought during 1865	367	658	66 31	24,355 09
" " " old wheels	202	1,176	48 87	9,897 22
Showing total iron	925	700		59,028 88
From which is to be deducted:				
Iron on hand January 1, 1866 (100 tons, cost per ton $66 31, amount $6,631 00)				
Estimated as used for tires (4 tons, cost per ton 48 87, amount 195 48)	104			6,826 48
Leaving as amount used in 1865	821	700		52,202 40
2,893 wheels, weighing (505 tons 1,217 lbs.)				
To which add for loss in casting (59 tons 1,029 lbs.)	633	2,246		44,024 09
Leaves an excess of	167	722	$48 87	$8,178 31

And as Samuel First testifies that old wheels were on hand one year in large quantity, this excess is carried forward to 1866.

484	Tons.	Lbs.	Cost per ton.	Total cost.
1866.				
A. L. Mowry had on hand January 1, 1866	100		$66 31	6,631 00
Bought during 1866	471	625	62 32	29,374 30
" " " old wheels	240	88	49 27	11,826 35
Old wheels brought forward as on hand	167	722	48 88	8,178 31
Showing total iron	978	1,435		56,009 96
From which is to be deducted:				
Iron on hand January 1, 1867 (243 tons, cost $62 33, amount $15,146 19)				
Estimated as used for tires (4 tons, cost 66 31, amount 265 24)	247			15,411 43
Leaving an amount used in 1866	731	1,435		40,598 53
4,050 wheels, weighing	810	1,657		
Leaving an apparent overestimate of weights	79	222		

485 *Schedule C*—Continued.

	Tons.	Lbs.	Cost per ton.	Total.
1867.				
A. L. Mowry had on hand January 1, 1867	243		$62 33	$15,146 19
Bought prior to April 11, 1867, old wheels	39	1,825	56 70	2,256 92
Showing total iron to April 11	282	1,825		17,403 11
491 wheels, weighing (104 tons 936 lbs.)				
To which add for loss in casting 10 per cent (10 tons 1,006 lbs.)	114	1,936	$62 33	7,158 60
Leaves iron on hand, April 12th, 1867	167	2,157		$10,244 51

SCHEDULE C.—Concluded.

Recapitulation and summary of iron used.

Years.	For annealed wheels.			For unannealed wheels.			For tires.			On hand.			Aggregate.		
	Tons.	Lbs.	Cost.	Tons.	Lbs.	Cost.	Tons.	Lbs.	Cost.	Tons.	Lbs.	Cost.	Tons.	Lbs.	Cost.
1861	229	1,434	$5,480 25	60	57	1,455 13	5	.....	121 20	.....	.....	.....	294	1,491	$7,056 58
1862	394	1,246	11,316 94	.....	.....	.....	5	.....	151 80	.....	.....	.....	399	1,246	11,468 74
1863	612	562	24,972 59	21	772	692 37	4	.....	121 44	.....	.....	.....	637	1,334	25,786 40
1864	1,102	937	73,288 27	.....	.....	.....	4	.....	244 56	.....	.....	.....	1,106	937	73,532 83
1865	653	2,246	44,024 09	.....	.....	.....	4	.....	195 48	.....	.....	.....	657	2,246	44,219 57
1866	731	1,435	40,598 53	.....	.....	.....	4	.....	265 24	.....	.....	.....	735	1,434	40,863 77
1867	114	1,936	7,158 60	.....	.....	.....	.....	.....	.....	167	2,157	$10,244 51	282	1,825	17,403 11
Total	3,839	724	$206,839 27	81	829	$2,147 50	26	.....	$1,099 72	167	2,157	$10,244 51	4,114	1,442	$220,331 00

487 SCHEDULE D.—*Amount and cost of labor required each year.*

Years.	Number of wheels made.	Computed on First's testimony, 8 wheels per day for 9 men; 12 wheels for 11 men; 16 wheels per day for 13, etc.	Wheels.		Days.	Cost per day.	Total cost.
1861	1,058	9 men making 8 per day would make..	1,058	wheels in..	132½	$11 75	$1,553 94
1862	1,611	9 " " " " " " "	1,611	" "	201⅛	11 75	2,366 16
1863	3,477	9 " Jan. 1st to Oct. 1st, " "	1,872	*" "	234	12 25	2,866 50
		9 " Oct. 1st to Dec. 31st, " "	624	" "	78	14 50	1,131 00
		2 " Jan. 1st to Oct. 1st, " "	936	" "	234	4 00	936 00
		2 " Oct. 1st to Dec. 31st, " "	45	" "	11¼	4 00	45 00
		Being less than 12 wheels per day.	3,477	would cost.	"	" "	4,978 50
1864	6,662	9 men making 8 wheels per day make.	2,496	wheels in..	312	17 42	5,435 04
		4 " " 8 " " " "	2,496	" "	312	9 09	2,836 08
		4 " " 8 " " " "	1,670	" "	208¾	9 09	1,897 54
		Being less than 24 per day.	6,662	would cost.	"	" "	10,168 66
1865	2,893	9 men making 8 per day would make..	2,496	wheels in..	312	20 14	6,283 68
		2 " " 2 " " " "	397	" "	198½	6 46	1,282 31
		Being less than 10 per day.	2,893	would cost.	"	" "	7,565 99
1866	4,050	9 men making 8 per day would make..	2,496	wheels in..	312	19 46	6,071 52
		4 " " 8 " " " "	1,554	" "	194¼	10 30	2,000 78
		Being less than 16 per day.	4,050	would cost.	"	" "	8,072 30
1867	491	9 men making 8 per day would make..	491	wheels in..	61⅜	19 71	1,209 70
Total.	20,242						

*In the calculations the extra men are calculated at the highest wages paid.

SCHEDULE E.—*Charcoal, coke, sand, and flour.**

Year.	No. of wheels.	Cost per wheel.	Total cost.
1861	1,058	$1 17	$1,237 86
1862	1,611	1 17	1,884 87
1863	3,477	1 17	4,068 09
1864	6,662	1 17	7,794 54
1865	2,893	1 17	3,384 81
1866	4,050	1 17	4,738 50
1867	491	1 17	574 47
Totals	20,242	$1 17	$23,683 14

* Samuel First's tables, p. 3.

SCHEDULE F.—*Drayages.***

Year.	Tons of iron.	Tons of wheels.	Total tons.	Drayage per ton.	Total drayages.
	Tons. *Lbs.*	*Tons.* *Lbs.*	*Tons.* *Lbs.*		
1861	229 1,434	208 1,716	438 882	$2 00	$876 00
1862	394 1,246	346 544	740 1,790	2 00	1,482 00
1863	612 562	612 562	1,224 1,124	2 00	2,449 00
1864	1,102 937	1,102 937	2,205 1,874	2 00	4,411 00
1865	653 2,246	594 1,217	1,248 1,195	2 00	2,497 00
1866	731 1,435	731 1,435	1,462 602	2 00	2,924 00
1867	114 1,936	104 936	219 1,604	2 00	440 00
Totals	3,839 724	3,700 543	7,539 1,267	$2 00	15,079 00

** Samuel First's tables, p. 4.

SCHEDULE G.—*Sundry annual expenses.*—(*April*, 1861, *to April*, 1867.)*

Years.	Water rate.	State taxes.	Insurance.	Interest on capital.	Ware & tear.	Salaries.	Total ex. per annum.	Expenses per day.	No. of days.	Aggregate.
1861	$30 01	$172 89	$168 75	$2,025 00	$450 00	$1,012 50	$3,849 15	$16 45	132½	$2,175 51
1862	26 67	217 41	225 00	2,700 00	600 00	1,350 00	5,119 08	16 41	201½	3,304 55
1863	32 00	409 23	225 00	2,700 00	600 00	1,350 00	5,316 23	"	312	5,316 23
1864	53 34	871 86	225 00	2,700 00	600 00	1,400 00	5,850 20	"	312	5,850 20
1865	53 34	513 35	225 00	2,700 00	600 00	1,560 00	5,591 69	"	312	5,591 69
1866	53 34	310 23	225 00	2,700 00	600 00	1,600 00	5,488 57	"	312	5,488 57
1867	"	"	"	675 00	150 00	400 00	1,225 00	15 70	61½	963 59
Total	$238 70	$2,494 97	$1,293 75	$16,200 00	$3,600 00	$8,612 50	$32,439 92	"	"	$28,690 34

SCHEDULES.

H.

Government taxes.†

Years.	Amount. paid.
1863	$737 90
1864	2,441 91
1865	2,293 73
1866	2,708 36
1867	322 50
Total	$8,504 40

I.

Commissions.‡

Years.	Total paid.	For wheels.	On wheels.
1861	$50 00	"	$50 00
1862	100 00	"	100 00
1863	595 00	"	595 00
1866	150 00	"	150 00
"	127 63	½	79 97
1867	132 31	½	49 62
Total	$1,154 94	"	$1,024 59

J.

Repairs and freight.‖

(AS PER FIRST'S DEPOSITION PAGE 26.)

Total	$2,541 34	
Say two-thirds		1,694 23
Freight on wheels		300 00
Total		$1,994 23

* Samuel First's tables.
† " " " and testimony, page 70, answer 2.
‡ " " " page 73, Exhibit C. M. N.
‖ First's statement, pp. 25, 26.

489 SCHEDULE K.—*Showing loss by bad debts, etc.*

1864.—Discount paid on quartermaster's vouchers, per Samuel First's tables, page 6, $12,803 43, the amount of which sum to be credited to wheel account is ascertained by the following calculation:

Of the wheels sold in 1864:			
July	284 at	$24 50	$6,958 00
August and September	626 at	30 00	18,780 00
October, November, and December	1,522 at	30 00	47,182 00
* Being number required on 304 cars	2,432 sold for.		$72,920 00
On which amount			12 per cent.
Gives a discount of			$8,750 40
1867.—A. L. Danby's account, $536 00, of which seven-eighths † =			469 00
Showing total loss by bad debts, etc			$9,219 40

* The wheels upon which the discount is allowed brought the highest prices obtained in 1864.
† One-eighth being estimated for axes.

SCHEDULE L.—*Being a summary of preceding schedules, and showing total cost of manufacturing and selling annealed wheels.*

Schedule.	1861.	1862.	1863.	1864.	1865.	1866.	1867.	Aggregate.
C	$5,480 25	$11,316 94	$24,972 59	$73,288 27	$44,024 09	$40,598 53	$7,158 60	$206,839 27
D	1,553 94	2,366 16	4,978 50	10,168 66	7,565 99	8,072 30	1,209 70	35,915 25
E	1,237 86	1,884 87	4,968 09	7,794 54	3,384 81	4,738 50	574 47	23,683 14
F	876 00	1,482 00	2,449 00	4,411 00	2,497 00	2,924 00	440 00	15,079 00
G	2,175 51	3,304 55	5,316 23	5,850 20	5,591 69	5,488 57	963 59	28,690 34
H	" "	" "	737 90	2,441 91	2,293 73	2,708 36	322 50	8,504 40
I	50 00	100 00	595 00	" "	" "	229 97	49 62	1,024 59
J	159 74	526 76	131 94	457 59	673 66	39 90	4 64	1,994 23
K	" "	" "	" "	8,750 40	" "	" "	469 00	9,219 40
Total	$11,533 30	$20,981 28	$43,249 25	$113,162 57	$66,030 97	$64,800 13	$11,192 12	$330,949 62

490 SCHEDULE M.—*Showing annual profits realized.*

1861.	1,058	wheels made, cost		$11,533 30
	334	" on hand Jan. 1, 1862, cost		3,640 98
	724	wheels, cost in 1861		$7,892 32
	"	" sold in 1861, for	$9,035 00	
		Profit on 724 wheels		1,142 68
				$9,035 00
1862.	334	wheels cost in 1861		$3,640 98
	1,241	" " " 1862		16,162 47
	1,575	" "		$19,803 45
	"	" sold in 1862, for	$20,925 00	
		Profit on 1,575 wheels		1,121 55
				$20,925 00
1863.	370	wheels cost in 1862		$4,818 81
	3,072	" " " 1863		38,215 68
	3,442	" "		$43,034 49
	"	" sold in 1863, for	$53,988 50	
		Profit on 3,442 wheels		10,954 01
				$53,988 50

1864.	405	wheels cost in 1863		$5,033 57
	5,802	" " " 1864		98,556 64
	6,207	" "		$103,590 21
	"	" sold in in 1864, for	$152,854 00	
		Profit on 6,207 wheels		49,263 79
				$152,854 00
1865.	860	wheels cost in 1864		$14,605 93
	2,644	" " " 1865		60,349 30
	3,504	" "		$74,955 23
	"	" sold in 1865, for	$86,904 00	
		Profit 3,504 wheels		11,948 77
				$86,904 00
1866.	249	wheels cost in 1865		$5,681 67
	3,315	" " " 1866		53,040 04
	3,564	" "		$58,721 71
	"	" sold in 1866, for	$72,902 00	
		Profit on 3,564 wheels		14,180 29
				$72,902 00
1867.	735	wheels cost in 1866		$11,760 09
	68	" " " 1867		1,570 14
	803	" "		$13,330 23
	"	" sold in 1867, for	$16,221 00	
		Profit on 803 wheels		2,890 77
				$16,221 00
		On hand, April, 1867, 423 wheels, which cost		$9,621 98

491 SCHEDULE N.—*Showing A. L. Mowry's profits on annealed wheels sold.*

Years.	Wheels sold.	Amount of sales.	Average selling price.	Average cost.	Average profit per wheel.	Wheels made.	Cost.	Profits.
1861	724	$9,035 00	$12 48	$10 90 1-10	$1 57 9-10	1,058	$11,533 30	$1,142 68
1862	1,575	20,925 00	13 28 3-8	12 57 1-3	71 1-5	1,611	20,981 28	1,121 55
1863	3,442	53,989 30	15 68 1-2	12 50 1-4	3 18 1-4	3,477	43.249 25	10,954 01
1864	6,207	*152,854 00	24 64 1-5	16 70 1-10	7 94 1-5	6,662	113,162 57	49,263 79
1865	3,504	86,904 00	24 80 1-9	21 39 1-9	3 41	2,893	66,030 97	11,948 77
1866	3,564	72,902 00	20 45 1-2	16 47 5-8	3 97 7-8	4,050	64,800 13	14,180 29
1867	803	†16,221 00	20 20	16 60	3 60	68	1,570 14	2,890 77
Total..	19,819	‡$412,829 50	$20 83	$16 21 3-10	$4 61 7-10	19,819	$321,327 64	$91,501 86

*6,203 wheels sold for	$152,774 00
4 " " " (Schedule A)	80 00
	$152,054 00
†767 wheels sold for	$15,724 00
29 " 26 inches, (schedule A,) a. $14	406 00
7 " 24 inches, (" ,) a. $13	91 00
	$16,221 00
‡Per master's findings from sales books	412,252 50
" " " " schedule A	577 00
	$412,829 50

SUMMARY.

19,819	wheels, sold for		$412,829 50
423	" on hand, which cost		9,621 98
20,242	"		$422,451 48
	" sold, cost 19,819	$321,327 64	
	" on hand " 423	9,621 98	
20,242			330,949 62
	Profits realized		91,501 86

492 SCHEDULE O.—*Interest on profits realized.*

Months.	Number of wheels sold.	Profit each month.	Interest to Jan. 1, 1862, *a* 6 per cent.
April	36	$56 84	$2 27
May	72	112 68	3 97
June	117	184 84	5 54
July	64	103 05	2 52
August	166	262 11	5 24
September	31	48 94	73
October	73	115 26	1 15
November	103	162 63	81
December	62	97 89	
Total	724	$1,143 14	$22 23

1861.

Average selling price		$12 48
Cost per wheel		10 90 1-10
Profit per wheel		$1 57 9-10
Total		$1,143 14
Less amount due to neglect of decimal		46
Total profit		$1,142 68
Interest:		
To Jan. 1, '62	$22 23	
Jan. 1, 1862, to Aug., 1868, 6 years and seven months, at 6 per cent	451 35	473 58
Aggregate		$1,616 26

Months.	Number of wheels sold.	Profit each month.	Interest to Jan. 1, 1863, *a* 6 per cent.
January	146	$103 95	5 71
February	215	153 08	7 65
March	216	153 79	6 92
April	117	83 30	3 33
May	30	21 36	74
June	190	135 28	4 05
July	54	38 44	96
August	4	2 84	05
September	31	22 07	33
October	408	290 49	2 90
November	138	98 25	49
December	26	18 51	
Total	1,575	$1,121 36	$33 13

1862.

Average selling price		$13 28½
Cost per wheel		12 57½
Profit per wheel		71 1-5
Total		$1,121 36
Add for disregarded decimals		19
Total profit		$1,121 55
Interest:		
To Jan. 1, '63	$33 13	
Jan. 1, 1863, to Aug. 1, 1868, five years and seven months, at 6 per cent	375 71	408 84
Aggregate		$1,530 39

493

Months.	Number of wheels made.	Profit each month.	Interest to Jan. 1, 1864, *a* 6 per cent.
January	52	$165 49	$9 10
February	186	591 94	29 59
March	430	1,368 47	61 68
April	188	598 31	23 93
May	178	566 48	19 82
June	228	725 61	21 76
July	160	509 20	12 73
August	172	547 39	10 94
September	702	2,234 11	33 51
October	132	420 09	4 20
November	292	929 29	4 64
December	722	2,297 76	
Total	3,442	$10,954 14	$231 90

1863.

Average selling price		$15 68¼
Cost per wheel		12 50¼
Profit per wheel		$3 18¼
Total		$10,954 14
Less decimals omitted		13
Total profit		$10,954 01
Interest:		
To Jan. 1, '64	$231 90	
Jan. 1, 1864, to Aug. 1, 1868, 4 years and 7 months, at 6 per cent	3,012 35	3,244 25
Aggregate		$14,198 26

Months.	Number of wheels made.	Profit each month.	Interest to Jan. 1, 1865, a 6 per cent.
January	417	$3,311 81	$182 14
February	323	2,565 26	128 26
March	527	4,185 43	188 34
April	424	3,367 40	134 69
May	588	4,669 89	163 44
June	444	3,526 24	105 78
July	838	6,655 39	166 39
August	460	3,653 32	73 06
September	541	4,296 62	64 44
October	358	2,843 23	28 43
November	265	2,104 63	10 52
December	1,018	8,084 95	
Total	6,203	$49,264 17	$1,245 49

1864.		
Average selling price		$24 64 1-5
Cost per wheel		16 70 1-10
Profit per wheel		$7 94 1-5
Total		$49,264 17
Less decimals omitted		38
Total profit		$49,263 79
Interest:		
To Jan. 1, '64,	$1,245 49	
Jan. 1, to Aug. 1. 1868, 3 yr's 7 mo's, at 6 per ct.	10,591 71	11,837 20
Aggregate		$61,100 99

494

Months.	Number of wheels sold.	Profit each month.	Interest to Jan. 1, 1866, at 6 per cent.
January	313	$1,067 33	$58 70
February	123	419 43	20 97
March	119	405 79	18 26
April	187	637 67	25 50
May	177	603 57	21 12
June	201	685 41	20 56
July	430	1,446 30	36 65
August	142	484 22	9 68
September	261	890 01	13 35
October	242	825 22	8 25
November	570	1,943 70	9 71
December	739	2,519 99	"
Total	3,504	$11,948 64	$242 75

1865.		
Average selling price		$24 80 1-9
Cost per wheel		21 39 1-9
Profit per wheel		$3 41
Total		$11,948 64
Add decimals omitted		13
Total profit		$11,947 77
Interest:		
To Jan. 1, 1866	$242 75	
Jan. 1, 1866, to Aug. 1, 1868, 2 years and 7 months, at 6 per cent	1,852 05	2,094 80
Aggregate		$14,043 57

Months.	Number of wheels sold.	Profit each month.	Interest to Jan. 1, 1867, at 6 per cent.
January	421	$1,674 85	$92 12
February	207	823 61	41 18
March	228	907 16	40 82
April	67	266 59	10 66
May	326	1,297 08	45 40
June	105	417 78	12 53
July	181	720 16	18 00
August	219	871 35	17 43
September	495	1,969 49	29 54
October	543	2,160 46	21 60
November	316	1,257 28	6 29
December	456	1,814 31	"
Total	3,564	$14,180 12	$335 57

1866.		
Average selling price		$20 45 1-2
Cost per wheel		16 47 5-8
Profits per wheel		$3 97 7-8
Total		$14,180 12
Add decimals omitted		17
Total profit		$14,180 29
Interest:		
To Jan. 1, 1867	$335 57	
Jan. 1, 1867, to Aug. 1, 1868, 1 year and 7 months, at 6 per cent	1,347 13	1,682 70
Aggregate		$15,862 99

495

Months.	Number of wheels sold.	Profit each month.	Interest to Jan. 1, 1868, at 6 per cent.
January	232	$835 19	$45 94
February	179	644 39	32 22
March	392	1,411 19	63 50
Totals	803	$2,890 77	$141 66

1867.		
Average selling price		$20 20
Cost per wheel		16 60
Profit per wheel		$3 60
Total profit		$2,890 77
Interest:		
To Jan. 1, 1868	$141 66	
Jan. 1, '68, to Aug. 1, '68, 7 months, at 6 per cent	101 18	242 84
		$3,133 61

Recapitulation of Schedules N and O.

Years.	Profits.	Interest.	Aggregate.	Mem:
1861.....	$1,142 58	$473 58	$1,616 26	1867.
1862.....	1,121 55	408 84	1,530 39	
1863.....	10,954 01	3,244 25	14,198 26	April 11th,
1864.....	49,263 79	11,837 20	61,100 99	
1865.....	11,948 77	2,094 80	14,043 57	On hand 423 wheels,
1866.....	14,180 29	1,682 70	15,862 99	
1867.....	2,890 77	242 84	3,133 61	which cost
Totals.....	$91,501 86	$19,984 21	$111,486 07	$9,621 98.

496 United States circuit court, southern district of Ohio. In equity.

ASA WHITNEY
vs.
ALBERT L. MOWRY. } No. 534.

To the honorable the judges of the circuit court of the United States, within and for the sixth circuit and southern district of Ohio, in chancery sitting:

The undersigned, special master, to whom this cause was referred, with directions to ascertain and take, and state, and report to the court, an account of the gains, advantages, and profits which the defendant above named has received, or which have arisen or accrued to him from infringing the patent of the plaintiff, set forth and described in the pleadings in said cause, and in the decree therein, by the manufacture, use, or sale of cast-iron car wheels made by the use of the improvement patented in and by said patent, begs leave respectfully to report that he has taken the depositions of Samuel First, A. L. Mowry, Daniel McLaren, Richard Bromley, and Noyes G. Green, witnesses produced before him by the parties, and herewith files the same; and there has been taken and submitted to him the testimony of Asa Whitney and William Helme, whose depositions are also herewith filed.

There have also been furnished to the undersigned, upon his requisition, proved tables and transcripts prepared by the witness Samuel First, from the books of the respondent A. L. Mowry; and other
497 tables prepared from the books, vouchers, and documents of said respondent have been submitted to the undersigned by agreement of the parties, all of which are herewith filed.

Said tables and transcripts show the quantity and cost of cold-blast iron and old car wheels (the material used by the respondent for manufacturing cast-iron car wheels) from January 1, 1861, to April 7, 1867; the amount and cost of labor in such manufacture; the amount and cost of charcoal, coke, sand, and flour, expense of drayage of iron and wheels; amounts paid and chargeable for water rate, State taxes, insurance, interest on capital, wear and tear of machinery, salaries, Government taxes paid on wheels manufactured, commissions on sales of annealed wheels, repairs of foundry and machinery employed in said manufacture, freight paid on wheels sold, and losses by bad debts or discount on bills for annealed wheels, during said period from April 1, 1861, to April 7, 1867.

Said tables and transcripts further show the quantity of iron and the number and sizes of wheels on hand January 1st in each year, and the number and sizes of wheels on hand June 10, 1867.

The books of account of said respondent have also been submitted to, and examined by, the undersigned, and from them he has made up the numbers, sizes, and prices of annealed wheels made and sold by A. L. Mowry the respondent, from the month of April, 1861, to the month of April, 1867, as shown by the tables herewith filed.

From the data above enumerated, the master finds:

I. That Albert L. Mowry, defendant, began the manufacture and sale of car wheels made by the use of the improvement patented to the complainant, and referred to in the decree in this cause, in the month of April, A. D. 1861, and continued such manufacture and sale until the 7th day of April, A. D. 1867, the date of the injunction granted in this cause. That during said period, the said Albert L. Mowry manufactured, by the use of said improvement, twenty thousand two hundred and
498 forty-two (20,242) cast-iron car wheels. That the total cost of the same, including cost of material, labor, wear and tear of machinery, taxes—national, State, and local—interest on capital, insurance, salaries, drayages, commissions, bad debts and discounts, water rates, charcoal, coke, sand, and flour, and repairs as aforesaid, was three hundred and forty thousand nine hundred and forty-nine dollars and sixty-two cents ($340,949 62.)

That nineteen thousand eight hundred and nineteen (19,819) of said wheels, which cost three hundred and thirty-one thousand three hundred and twenty-seven dollars and sixty-four cents, ($331,327 64,) were sold by the respondent, whose gross receipts from such sales were four hundred and twelve thousand eight hundred and twenty-nine dollars and fifty cents, ($412,829 50,) and that the respondent had remaining on hand in April, 1867, four hundred and twenty-three (423) wheels which represented a cost of nine thousand six hundred and twenty-one dollars and ninety-eight cents, ($9,621 98,) and represented a market value, at the then selling prices, of eight thousand five hundred and sixty-eight dollars ($8,568.) That the profits realized by the said respondent upon the said sales of 19,819 wheels were eighty-one thousand five hundred and one dollars and eighty-six cents, ($81,501 86,) of which there were realized in—

1861	$1,142 68
1862	1,121 55
1863	10,954 01
1864	49,263 79
1865	11,948 77
1866	5,995 28
1867, January, February, and March	1,075 78
Total	$81,501 86

and the interest upon said profits from the time of their accruing, that is to say, from the first day of the month next ensuing the sales,
499 to the first day of August, A. D. 1868, at 6 per cent., amounts to eighteen thousand eight hundred and sixty dollars and thirty-eight cents, ($18,860 38,) making a total of profits and interest of one hundred thousand three hundred and sixty-two dollars and twenty-four cents (100,362 24.)

II. That, on account of the charcoal and extra labor, the cost of the annealed wheels so manufactured was, on the average, twenty-five cents per wheel more than the cost of the same wheels, without the use of the charcoal, or the reheating process, would have been; and that no addi-

tion was made to the price of wheels on account of their having been manufactured by said process of reheating.

The master herewith submits the schedules and exhibits showing the computations by which he arrived at the results stated in Finding No. 1 above.

All which is respectfully submitted.

(Signed). GEORGE R. SAGE,
Special Master.

CINCINNATI, *August* 1, 1868.

Master's fees.

For examination of books, preparation, correction, & revision of accounts, tables, and schedules, examinations of witnesses, orders, references and hearings between June 3rd 1867, and August 1st, 1868, 40 days, at $50 per day	$2,000 00
Fees paid, service of subpœna	2 00
" " clerk, writing depositions	3 90
" " comm'r, at Philadelphia by complainant	20 00
Total	$2,025 90

500 Circuit court of the United States, southern district of Ohio.

ASA WHITNEY
vs.
ALBERT L. MOWRY. } No. 534.

To the honorable the judges of the circuit court of the United States within and for the sixth circuit and southern district of Ohio, in chancery sitting:

The undersigned begs leave to report to the court that, since the filing of his report hereinbefore, his attention has been directed to certain errors therein, beginning on page 15 of the printed exhibits filed with the original report, where $50,598 53 should be $40,598 53, and thenceforth in said exhibits on pages 17, 20, 21, 22, 25, and 26, resulting from carrying forward the first error above, so that on page 26 the totals in the recapitulation of Schedules N and O should be, of profits, $91,501 86; of interest, $19,984 21; and aggregate, $111,486 07.

The master herewith files a reprint, corrected, of the pages aforesaid, and asks that the same be substituted for the pages originally filed, and bearing the same numbers.

And the master desires to correct his first finding as follows:

First. By striking out, at the close of the first paragraph, the
501 words and figures "three hundred and forty thousand nine hundred and forty-nine dollars and sixty two cents, ($340,949 62,)" and inserting "three hundred and thirty thousand nine hundred and forty-nine dollars and sixty-two cents, ($330,949 62,)" which the master finds is the true statement of the cost of said wheels.

Second. By striking out, in the second paragraph, the words and figures "three hundred and thirty-one thousand three hundred and twenty-seven dollars and sixty-four cents, ($331,327 64,)" as the cost of 19,819 of said wheels, and inserting "three hundred and twenty-one thousand three hundred and twenty-seven dollars and sixty-four cents, ($321,327 64,)" which the master finds is the true statement of the cost of said wheels.

Third. By striking out, in the second paragraph of said finding, the words and figures "eighty-one thousand five hundred and one dollars and eighty-six cents, ($81,501 86,)" as the profits realized upon the sales of said 19,819 wheels, and inserting "ninety-one thousand five hundred and one dollars and eighty-six cents, ($91,501 86,)" which the master finds is the true statement of said profits.

Fourth. By striking out, as the profits of 1866, (in the statement of profits per annum,) "$5,995 28," and inserting "$14,180 29," and in 1867 "$1,075 78," and inserting "$2,890 77," and by striking out, as the total, "$81,501 86," and inserting "$91,501 86," which several sums, so inserted, the master finds are correct statements of said profits and total.

Fifth. By striking out, from the statements of interest upon said profits, the words and figures "eighteen thousand eight hundred and sixty dollars and thirty-eight cents, ($18,860 38,)" making a total of profits and interest of one hundred thousand three hundred and sixty-two dollars and twenty-four cents, ($100,362 24,)" and inserting "nineteen thousand nine hundred and eighty four dollars and twenty-one
502 cents, ($19,984 21,)" making a total of profits and interest of one hundred and eleven thousand four hundred and eighty-six dollars and seven cents, ($111,486 07.)

The master further reports that he has been requested, by counsel for the defendant, since the filing of the original report herein, to find as follows:

"If the court should determine, as matter of law, that the defendant is liable to account for the entire profit made by him in his manufacture and sale of annealed car wheels, (19,819,) then I find that he has made profit to the amount of $91,501 86.

"I do find, however, that the defendant's business was not increased by the annealing process employed in the manufacture of wheels; that he would have sold as many wheels if he had not employed the complainant's process; that the complainant's process increased the cost of the wheels, while no increase over unannealed wheels was made in the price; that consequently the defendant made no profit simply by reason of annealing or employing the complainant's process for cast-iron wheels made by him, and would have made a larger profit than $91,501 86 if he had not annealed his wheels."

This finding the master declines to make. He is not able to find in the testimony any warrant for finding what would have been, had the defendant not done what he did do. Besides, the testimony does not show what was the extent of the business of the defendant before he commenced using the process enjoined in this cause; and if it did, the tables submitted with the report of the master show that the defendant's business very largely increased from 1861 to 1865—that is, during the war of the rebellion. The books of the defendant, which were submitted to the master, show that among the heaviest orders for wheels were those from or on account of the Government of the United
503 States. The defendant himself testifies that, during the war, a larger number of wheels were required, and we know, as matter of public history, that the demands of the Government for transportation for troops, supplies, &c., enlarged the business of railroads and of manufacturers of car wheels and other materials for railroads beyond precedent. The testimony, too, shows that, since 1865, the business of the defendant has diminished.

Now the master cannot undertake to determine whether the use of the process complained of in this cause did or did not bring an increase

of business to the defendant. He has, in his opinion, nothing to do with hypotheses. It is his business to deal with facts only. He does find, however—

1st. That the defendant, prior to the first of April, 1861, and without the use of the process complained of in this cause, had built up his business to its then condition.

2d. That the use of the process complained of in this cause did not diminish, but did increase the cost of making the wheels manufactured by the defendant, as set forth in finding No. 2 in the original report herein.

3d. That the 19,819 wheels manufactured and sold by the defendant by the use of the process complained of in this cause, had they been manufactured by the use of the process adopted by the defendant prior and up to April, 1861, and been sold at the prices which they actually did bring, would have yielded the defendant a profit of $4,754 75 greater than the profit he did in fact realize from the manufacture and sale of said wheels.

4th. That the defendant did not, when he began the use of said process, nor afterwards, while he continued its use, make any difference in the quality of iron used for the manufacture of car wheels, nor in the weight or form of car wheels, nor by reason of the use of such process in their price.

5th. That the defendant was unable to discover that his business was increased by the use of said process; that it was with a great deal of difficulty that he introduced the annealed wheels; that the railroad companies purchasing from defendant preferred the old wheels; that is to say, those manufactured by the process used by the defendant prior to April, 1861, for one or two years after the new annealed wheels—that is to say, the wheels annealed by the process complained of in this cause—were first introduced, and that since the defendant has been enjoined in this cause, and has abandoned the use of the process complained of, he has had the same customers, (excepting the Little Miami and the Columbus and Xenia Railroad Companies, and it does not appear that said companies have withdrawn their custom on account of said abandonment,) and has sold the wheels he has since manufactured without the process complained of as readily as those manufactured by the use of said process and at the same prices.

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6th. That during nine months preceding June, 1868, the defendant has been operating his foundry every other day only, and manufacturing from eight to twelve wheels for each day the foundry was operated; and that in the years 1866 and 1867 he operated his foundry full time one-fourth of the year, and half time the rest of the year.

7th. That since the defendant abandoned said process complained of, he has manufactured a wheel called the Washburne wheel, more properly called the Atwood wheel, not exactly after Washburne's patent, but in a modified form—the same in form as before and during the infringement—using pits made of iron, sunk in the ground, taking the wheels from the mould at the same degree of heat as in the process complained of in this cause, placing them in the pits without any fuel, covering the pits up, leaving the wheels in four or five days; then taking them from the pits, and allowing them to cool in the open air.

8th. That the defendant, in the manufacture of the 20,242 wheels referred to in finding No. 1 of the original report herein, used no process for annealing or slow cooling, excepting that complained of in this cause, and that that process was applied to the castings bearing the shape of car wheels; and by its application to said castings,

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said 20,242 car wheels were made, and rendered fit for the market and for use.

9th. That, in 1849, the complainant granted a license under his said patent, at a royalty of one dollar per wheel; a few wheels were made by the licensees thereunder, and paid for at that rate, when the license was revoked and cancelled.

That, in 1851, the complainant granted a license to another party, but no wheels were made under it, and it was very soon revoked and cancelled.

That, in 1847, the complainant started the business of manufacturing car wheels by said process, in company with his son, George Whitney, under the firm-name of A. Whitney & Son, said George Whitney having one-third interest in said business.

That, from 1850 to 1861, both inclusive, said complainant continued said business with his sons, and under the firm-name of A. Whitney & Sons, the firm paying said complainant one dollar per wheel aside from his proportion of the profits; said sum of one dollar per wheel being charged to the expense account of the business.

That, since 1861, said firm of A. Whitney & Sons have continued said business; the complainant putting in his patent without charging the royalty theretofore paid, and the firm paying the expenses of the extension of said patent in 1862.

That, otherwise than and save as aforesaid, the complainant has kept the right under his said patent, exclusively and solely for his own use and enjoyment, uniformly declining and refusing numerous applications for licenses, and preferring to supply the demand for wheels from his own works, which he has enlarged from time to time, so that he has been able to supply such demand.

506 That, from 1847, to July 1st, 1866, said firms of A. Whitney & Son and A. Whitney & Sons, made by said patented process 464,475 wheels.

All of which is respectfully submitted.

GEORGE R. SAGE,
Special Master.

CINCINNATI, *September* 17, 1868.

United States circuit court, southern district of Ohio. In equity.

ASA WHITNEY
vs.
A. L. MOWRY.

It is hereby agreed that either party to the above suit may file such exceptions as may be desired, to the original and supplemental reports of the master on or before the thirteenth (13th) day of October next, but not later; and that exceptions filed on or before the day named, shall have the same effect, and be considered the same as if filed within the times provided by the rules of court.

It is also agreed that the questions arising upon exceptions to the said reports shall be argued as early in the October term of the court as counsel can be heard; all claim for further delay being hereby waived.

CHA'S B. COLLIER,
For Defendant.
HENRY BALDWIN, JR.,
For Complainant.

PHILADELPHIA, *Aug.* 27, 1868.

507 Circuit court of the United States, southern district of Ohio.

ASA WHITNEY }
vs
A. L. MOWRY. }

Exceptions of A. L. Mowry to the findings and reports of George R. Sage, esq., special master in the above-entitled cause.

The original report having been filed, without first being submitted to the defendant or his counsel, but having been withdrawn by the master from the files, and being now, together with a supplemental report submitted to counsel for inspection and objection, the defendant, by Charles B. Collier, his attorney, does now submit to the special master his objections to said findings and report, as follows, to wit:

FIRST.

In the first branch of his report the master states the aggregate number of wheels made and sold by the defendant during the interval of the infringement, in the making of which complainant's improvement was employed, to wit, 19,819. He then states the aggregate cost of said wheels, to wit, $330,949 62; he then states the aggregate of profits derived by the defendant from the sale of said wheels, to wit, $91,501 86, exclusive of interest.

This branch of the report is objected to, for the following reasons:

1st. It is not complete; the master has stopped short of the ultimate inquiry. He has found the total profits derived by the defendant from the manufacture and sale of 19,819 wheels, in the making of which the complainant's improvement was employed, but has made no apportionment of such profits.

508 The manufacture of a cast-iron railroad wheel, it is submitted to the master, is a succession of processes consisting: (1st.) In the mixing of the iron, having reference to the proper proportion of iron having the property of receiving a "chill." (2d.) In the melting and stirring of the metal. (3d.) In forming the wheel in a mould composed in part of sand and in part of iron; the object of the iron being to suddenly cool or "chill" the periphery of the wheel. (4th.) In the removal of the wheel, at a red heat, from the mould. (5th.) In prolonging the time of its cooling.

Each one of the above processes or steps is so far independent of the others as that it might be, if new, the subject-matter of letters-patent; but each and all is public property, and each and all was practised by Mr. Mowry, in making said 19,819 wheels; but he did something further to the wheels which the court has said was an infringement of Mr. Whitney's patent; that is, he reheated or "annealed" the wheels in connection with prolonging the time of their cooling.

Mr. Whitney claims this as his "improvement," prolonging the time of cooling in connection with annealing.

The rule or measure of damage, when the defendant's profits is made the criterion, as fixed by the supreme court, is not the profit upon the entire machine or manufacture, but only the profit realized by the use of the improvement infringed upon. You are to ascertain what part of Mowry's total profits was added by or due to the use of Whitney's improvement.

For the rule upon this question you are referred to the following cases:

Seymour vs. McCormick, 16 How., 480.
McCormick vs. Seymour, 3 Blatchf., 211.
Goodyear vs. Bishop, 2 Fisher, 154.
509 Burdell vs. Denig, 2 Fisher, 588.
Serrell vs. Collins, 1 Fisher, 289.
Bell vs. McCullough, 1 Fisher, 379.
Care vs. Brown, 2 Fisher, 273.

2d. If the master, in that branch of his report under consideration, intends to report $91,501 86 as the amount of profit realized and made by the defendant, by reason of the application by him to said 19,819 wheels of the complainant's improvement, then is the objection urged, that such finding is contrary to and unsupported by the testimony.

The testimony shows:

1st. That the application of the complainant's process of reheating or annealing, in connection with prolonging the time of cooling, added to the cost of the wheels at least 25 cents per wheel.

(See testimony of A. L. Mowry. Ans. to q. 11, p. 29, print.)

2d. That no saving was made in the weight of the wheels by reason of the application of this improvement.

(Mowry's testimony. Ans. to q. 6, p. 28, printed copy.)

3d. That no addition was made to the price of the wheels by reason of the application of this improvement.

(Mowry's testimony. Ans. to q. 9, p. 28, printed copy.)

4th. That no change was made in the quality of iron used.

(Mowry's testimony. Ans. to q. 4, p. 27.)

5th. That there was no greater demand for the defendant's wheels by reason of the use of such improvement.

(Mowry's testimony. Ans. to q. 9, p. 28.)
(Daniel McLaren's testimony, pp. 36, 40.)
(Richard Bromley's testimony, pp. 42, 43, 45.)

510 It is insisted, in view of these facts, as shown by uncontradicted testimony, that the master should report to the court in substance, as follows:

I do find that the defendant has realized an aggregate profit of $, from the manufacture and sale of 19,819 car wheels, in the making of which, he employed the complainant's improvement, but the testimony does not show that the adoption or use of that improvement made profit for the defendant, inasmuch as its employment added to the cost of the wheels, and did not add to their selling price, nor did it enable the defendant to sell a greater number of wheels than he would have sold without the use of such improvements.

3d. This branch of the report is objected to for the further reason that the cost of said wheels is not correctly stated.

In support of this objection, the master's attention is directed to parts of his report, as follow, to wit: On page 8, printed copy, recapitulation of Schedule A, the master states the total number of annealed wheels made by the defendant, 20,242. On the same page, he states the aggregate weight of these wheels, to wit, 9,578,931 lbs.

On page 17, Schedule C, the master states the total quantity of iron used by the defendant for the manufacture of annealed wheels, to wit, 3,839 tons and 724 lbs.=8,707,576 lbs.

It will be observed that the weight of the wheels as given by the mas-

ter, exceeds the quantity of iron stated to have been used in making them, by 871,355 lbs. or 428 plus tons.

It is obvious that the master has erred in either overstating the number of wheels, or in understating the quantity of iron used in making them; in either case, the final result must necessarily be very different from that found in the report; thus, it will be seen, that if it required
428 tons of iron to make these wheels, more than is estimated by
511 the master, the cost of the wheels was greater than the cost reported, by so much as was the cost of that amount of iron.

Taking the average cost of iron during the period of infringement, as stated in the report, and the cost of this additional amount of iron, would be about $25,000.

Again, the master reports (Schedule B, p. 9) as the total amount of iron bought, used, and on hand by Mowry during the interval of infringement, 4,114 tons 1,442 lbs., which reduced to pounds, at 2,268 lbs. to the ton=9,334,994 lbs.

From this is to be deducted as stated in Schedule C, p. 17:

	T. Lbs.	Lbs.	
For unannealed wheels..	81,829	= 184,537	
" tires.....	26	= 58,968	
" am't left on hand ...	167,2157	= 380,913	
			624,418

Leaving for 20,242 annealed wheels, 3,839 tons, or 8,707,576 lbs.

This, however, it will be observed, makes no allowance for waste of iron in the process of casting, &c., while the testimony shows that there is a large waste.

Green, Mowry's foreman, testifies (page 74, printed copy) "that the loss in melting and casting iron is ten per cent.; that is, a ton of iron, 2,268 pounds, gives 2,041 pounds of car wheels.

Samuel First, page 75, states the loss in melting and recasting old wheels at twelve and a half per cent.

Making a calculation on the percentage of loss stated by Green, and it will be seen that the 3,839 tons and 724 lbs., at 2,042 lbs. to the ton, would yield only 7,839,962 pounds of wheels, which shows that the master has not allowed enough iron, by the difference between the weight of the annealed wheels, 9,578,931, and the weight of iron, at 2,042 lbs. to the ton 7,839,962

1,738,969 lbs.

512 This is equal to about 767 tons, which, at the average cost of iron as reported, (page 9,) would amount to about $45,000, showing an under statement of the cost of 20,242 wheels by that amount.

4th. The testimony discloses that the defendant had obtained letters-patent, under which he annealed and cooled his car wheels; that he was also a licensee under the Washburne, Atwood, and Murphy patents, and had employed the improvements secured by said patents, or some of them, in making said wheels. (See Testimony of Mowry, p. 32. First, p. 36.)

This, the first branch of the report, is objected to, for the further reason that no apportionment of profits has been made between the complainant's and the other improvements used by the defendant.

5th. The defendant objects to all that part of the report which relates to interest—first, because the complainant is not entitled to recover in-

terest; second, because the interest is calculated upon the entire profits of defendant's car-wheel business; third, because such profits, and consequently the interest, are erroneously stated.

SECOND.

Referring the master to the second branch of his report, his attention is called to parts of the testimony of the following-named witnesses: Daniel McLaren, page 36, ans. to quest. 6; same witness, pp. 40, 41; Richard Bromley, p. 43, ans. to quest. 11; same witness, quest. 18, 19, 20, and answers, p. 45; testimony of A. L. Mowry, quest. 2 and ans., p. 27; also, quest. 9 and ans., p. 28; and he is requested to add findings in substance as follows:

1st. That, prior to the time of the adoption by the defendant of the complainant's improvement, he, the defendant, prolonged the
513 time of cooling his wheels by placing them in pits, covered with dry sand, in some cases using air-tight pits without any sand, placing the wheels in the pits and allowing them to remain there four or five days; that, by reason of such treatment, they were finished and made ready for the market, and without further treatment were sold.

2d. That, in so far as there is testimony upon the subject, such testimony tends to prove that the application by the defendant to wheels manufactured by him of the complainant's improvement, did not make the commercial value of such wheels greater than the commercial value the same wheels would have had if that improvement had not been applied to them, and they had been treated in the manner the defendant treated them before the application of the complainant's improvement; that is, by placing them in pits and prolonging the time of their cooling without reheating or "annealing" them; and further such testimony tends to prove that the defendant sold no greater number of wheels, by reason of the use of complainant's improvement, than he would have sold had he continued the manufacture of wheels in the same manner as before the employment of that improvement.

If the master should modify his report and findings, by reason of the objections, or either of them, herewith submitted, he is respectfully requested to furnish the undersigned, as attorney for the defendant, a copy of the draft of the report and findings, as modified, before filing the same, in order that such further objections may be taken thereto as may be deemed advisable.

If no modification is made in the report and findings, the master is respectfully requested, at the same time he places it on file, to file therewith these objections; the same to be submitted to the court as the "Exceptions of the defendant to the report and findings of the master."

514 If the master shall decline to add to his report the additional findings as herein asked for, he is respectfully requested to state in his report the request and his refusal, and his reasons for so refusing; and he will in such case please regard such refusal as hereby objected to by the defendant.

A. L. MOWRY, *Def't*,
By CHA'S B. COLLIER, *his Att'y*.

PHILADELPHIA, *Sept.* 30, 1868.

515 United States circuit court, southern district of Ohio.

ASA WHITNEY
vs.
ALBERT L. MOWRY

Exceptions to the draft supplemental report of George R. Sage, esq., special master in said cause.

Complainant's counsel respectfully submits the following exceptions to said supplemental report, dated September 17th, 1868:

First exception. The evidence does not warrant the master in finding as matter of fact, "That the defendant did not, when he began the use of said process, nor afterwards while he continued its use, make any difference in the quality of iron used for the manufacture of car wheels, nor in the weight or form of car wheels, nor, by reason of the use of such process, in their price."

Second exception. The evidence does not warrant the master in finding as matter of fact, "That the defendant was unable to discover that his business was increased by the use of said process; that it was with a great deal of difficulty that he introduced the annealed wheels; that the railroad companies purchasing from defendant preferred the old wheels—that is to say, those manufactured by the process used by the defendant prior to April, 1861, for one or two years after the new annealed wheels—that is to say, the wheels annealed by the process
516 complained of in this cause—were first introduced; and that since the defendant has been enjoined in this cause, and has abandoned the use of the process complained of, he has had the same customers, (excepting the Little Miami and the Columbus and Xenia Railroad Companies, and it does not appear that said companies have withdrawn their custom on account of said abandonment,) and has sold the wheels he has since manufactured without the process complained of, as readily as those manufactured by the use of said process, and at the same prices."

HENRY BALDWIN, JR.,
Complainant's Att'y.

OCTOBER 2D, 1868.

517 United States circuit court, southern district of Ohio. In equity.

ASA WHITNEY
vs.
ALBERT L. MOWRY. } No. 534.

To the honorable the judges of the circuit court of the United States, within and for the sixth circuit and southern district of Ohio, in chancery sitting:

The master files herewith exceptions submitted by counsel for complainant, to the 4th and 5th findings of the supplemental report, and if it be proper for him to take any action thereupon, overrules both of said exceptions, with only this remark: The phrase "at the same prices," at the close of the 5th finding does not convey precisely the master's idea, and is not exactly correct. What the master intended to find, was that no change in prices had been made on account of the change in the mode of manufacture, although there may have been and

doubtless there have been actual changes in prices, caused by variations in the cost of iron, labor, &c. With this modification, the master submits the findings and the exceptions to the court.

The master also files herewith the exceptions of A. L. Mowry to the findings and reports made by the master.

The defendant and his counsel, who prepared the exceptions, are in error as to the original report having been filed without first being submitted to the defendant or his counsel. The draft of that report was furnished to counsel for the defendant, resident at Cincin-
518 nati, several days before it was filed, and the master finds by reference to his letter book, that, on the eighth day of August, 1868, the day on which the original report was filed, he mailed to the counsel who prepared the exceptions, a full copy of the original report, and sent to him a printed copy of the schedules and tables filed with the report, which was perhaps all that it was incumbent upon the master to do.

The master submits to the court the objections urged to the first finding of the original report, remarking that he has not undertaken to decide what is the proper rule of damages, but if they are to be measured by the profits resulting from the manufacture and sale of the wheels referred to in that finding, then the amount stated by the master, $91,501 86 is correct. And in this connection, while the master recognizes the succession of processes referred to by counsel, he has found that the fifth process, is that which converts what was by virtue of the preceding processes, only an iron casting into a car wheel. Without this final process, there can be no profit, but there must be a loss, for the casting is worth nothing more than its weight as iron, but the final process of annealing, changes the relation of every particle of iron in the casting to every other particle, and gives to the casting the essential qualities of a car wheel, thereby contributing all the profit realized. The process used in the manufacture of the 19,819 wheels referred to in the first finding in the original report, was that which the court has found was an infringement of the complainant's process, and the master understands that the court did not limit the infringement to the reheating process, but included also the slow cooling as employed in connection with the reheating.

The first additional finding requested is as follows: "I do find that the defendant has realized an aggregate profit of $91,501 86, from the manufacture and sale of 19,819 car wheels, in the making of which, he employed the complainant's improvement, but the testimony does
519 not show that the adoption or use of that improvement made profit for the defendant, inasmuch as its employment added to the cost of the wheels, and did not add to their selling price, nor did it enable the defendant to sell a greater number of wheels than he would have sold without the use of such improvement."

The master declines to make this finding, for reasons which will be hereinafter briefly stated.

The master is not convinced by the objections stated that the cost of the wheels was greater than reported.

The statement upon page 8 of the printed copy, recapitulation of Schedule "A," is of the estimated aggregate weight of wheels, while the allowance for iron is derived from the books of the defendant, which show, according to the testimony of Samuel First, defendant's book-keeper, the total of iron used in the manufacture of annealed car-wheels by the defendant. The conclusion of counsel that the master "has erred in either overstating the number of wheels, or in under-

stating the quantity of iron used in making them," leaves out of consideration the possibility of error in the estimate of the weight of wheels made by the defendant himself. If the master committed any error in this regard, it was in adopting the testimony of the defendant's books, rather than the defendant's estimate. The master's finding is, however, singularly verified by the defendant's sworn returns for Government taxes on castings. The total number of tons reported for 1864, 1865, 1866, and 1867, is 3,377$\frac{7}{8}$, three-fourths of which, being 2,533 tons, should be charged to wheel account, according to First's testimony. The master's allowance for the same years, according to Schedule "C," is 2,600 tons, or 67 tons more than the sworn return of the defendant.

Counsel request two additional findings:

First. "That, prior to the time of the adoption by the defendant of the complainant's improvement, he, the defendant, prolonged the
520 time of cooling his wheels by placing them in pits covered with dry sand, in some cases using air-tight pits without any sand; placing the wheels in the pits, and allowing them to remain there four or five days; that, by reason of such treatment, they were finished and made ready for the market, and without further treatment, were sold."

The master adopts this as a finding, and hereby reports it as such to the court:

Second. "That, in so far as there is testimony upon the subject, such testimony tends to prove that the application by the defendant to wheels manufactured by him, of the complainant's improvement, did not make the commercial value of such wheels greater than the commercial value the same wheels would have had if that improvement had not been applied to them, and they had been treated in the manner the defendant treated them before the application of the complainant's improvement; that is by placing them in pits and prolonging the time of their cooling without reheating or "annealing" them; and further, such testimony tends to prove that the defendant sold no greater number of wheels by reason of the use of complainant's improvement than he would have sold had he continued the manufacture of wheels in the same manner as before the employment of that improvement."

The master declines to make this finding. The first part of it has been substantially found, and is contained in the master's supplemental report, and the last part is only another form of a finding then requested and refused. How many wheels the defendant would have sold, had he continued the manufacture in the same manner as before the employment by him of the complainant's process, is, in the opinion of the master, matter of speculation, not of fact, and to be rejected for the same reason that speculative profits are not allowed. The
521 master regards the statements of the witnesses Bromley and McLaren, as to what purchases they would have made had the defendant manufactured unannealed wheels as speculations, rather than testimony. Besides, the fact that the defendant, from 1861 to 1867, and until he was stopped by injunction, manufactured, except in one or two instances, car wheels exclusively by the complainant's process, at an extra cost of twenty-five cents per wheel without corresponding advance in the selling price, and that he published a circular asserting the superior quality of wheels so manufactured, and that many railroad companies then using them would certify to that superior quality, seemed to the master to be entitled to some consideration; while the fact that the company which the witness Bromley represented, (not, however, as purchasing agent, but merely to make requisitions for purchases,) after

the defendant was enjoined and returned to the manufacture of what are styled unannealed wheels, transferred its orders to Nash, who manufactured annealed wheels, was put by the master against Bromley's assertion that they preferred the unannealed wheels; and the fact that a strong certificate, in favor of the annealing process, signed by the witness McLaren, as superintendent of the Cincinnati, Hamilton and Dayton Railroad Company, was attached to the published circular above referred to, qualified somewhat, in the master's opinion, the testimony of that witness that he opposed the annealing process. The master is not, therefore, able to see or to report that the annealing process, as used by the defendant, and which the court has decided was an infringement of the plaintiff's process, had no influence upon the defendant's business. He is of opinion that the findings contained in the supplemental report are as strong as the testimony warrants. These remarks are intended to apply, also, to the first finding requested by complainant's counsel, and hereinbefore refused.

522 The master has thus given his reasons for his findings and refusals as briefly as possible, and in response to the request of counsel.

Respectfully submitted.

GEORGE R. SAGE,
Special Master.

CINCINNATI, OHIO, *October 7th*, 1868.

Master's fee for supplemental report & additional findings, $200 00.

GEO. R. SAGE,
Special Master.

523 United States circuit court, southern district of Ohio.

ASA WHITNEY *vs.* A. L. MOWRY. } 534.

OCTOBER 21, 1868.

Before Justices Swayne & Leavitt, upon the exceptions of the complainant and defendant to the reports of the special master.

Opinion of the court as delivered by Justice Swayne.

The only question before us, as the case has been presented in the arguments just closed, is whether, by the master's report as it stands, the plaintiff is entitled to the entire amount of profits which have been made by the defendants as estimated. If that be clear, we need no further light on the subject, and there is no necessity for referring the matter back to the master for a further report, and for him to take further testimony in the case, leading to the proper solution of this point.

The claim of the patent is as follows: "I do not claim to be the inventor of annealing castings made of iron or other metal, when done in the ordinary way." That ordinary way is well understood in the history of the arts, and need not be remarked upon. "Nor do I claim to be the inventor of any particular form or kind of furnace in which to perform the process." There is here a clear implication and recognition of the right of others, notwithstanding the patent of the plaintiff

to perform this annealing process in the ordinary way, by means of a furnace used for that purpose.

524 "But what I do claim as my invention, and desire to secure by letters-patent, is the process of prolonging the time of cooling, in connection with annealing railroad wheels in the manner above described; that is to say, the taking them from the moulds in which they are cast before they have become so much cooled as to produce such inherent strain on any part as to impair its ultimate strength, and immediately after being thus taken from the molds depositing them in a previously-heated furnace or chamber, so constructed, of such materials, and subject to such control that the temperature of all parts of the wheels deposited therein may be raised to the same point, (say a little below that at which fusion commences,) when they are allowed to cool so fast and no faster, than is necessary for every part of each wheel to cool and shrink simultaneously together, and no one part before another."

Here, it will be observed, in relation to this claim, that two things are claimed, and everything else is disclaimed.

First. The reheating of the wheel to be annealed, and that reheating, in connection with the slow-cooling process, which slow-cooling process was known before in the history of the arts.

The reheating is that which is claimed to be new, and which this court has found, heretofore, to be new: this combination of the reheating with the old thing—the slow-cooling of the wheel.

Now, pursuing this line of thought and analysis, we find that railroad wheels are to be made of the same dimensions as before; they are to be of the same configuration as before; they are to be made of fused metal as before; the metal is of the same kind as before; it is to be fused in the same manner as before; it is to be introduced into the proper molds in the same manner as before; the wheel is to be completed—aside from the annealing process—in the same manner as before; it is to be taken from the molds in the same manner as before.

525 Up to this point the process of the patentee towards the accomplishment of the ultimate result, is just the same as would be pursued if the plaintiff's process had never been invented.

Here the roads fork, and the divergence commences. Now any person, irrespective of this patent, after the wheel has reached the point mentioned, would have the right, in consistency with this patent, immediately to put it into a pit—the right would exist, as I understand is conceded, to apply hot sand, sand previously heated—the right would exist to close the pit and exclude the air, and to subject the metal to the annealing process by slow cooling, as the phrase is, to such extent as this means or any other means known in the history and practised in the art of annealing prior to that time, might suggest. The plaintiff, then availing himself of all these means and instrumentalities, interposes, in the progress of the construction and completion of the wheel, a new element, the right to use which exclusively is secured to him; and that new element is simply, after the wheel has been taken from the mold, and has been placed in the pit, to subject it to a reheating—a tempering which involves the reheating of the iron structure; and then that reheating is to be connected with the old process of slow-cooling. In this reheating, in combination with slow-cooling, lies the novelty, the utility, the vitality of this patent.

Viewing this subject in this light, it does not seem to us that there is anything in the case, any fact or feature, which should take it up from

the rule laid down by the Supreme Court, and which stands unshaken, in the case of Seymour vs. McCormick, (16 Howard.)

Now I have referred to this extent upon the case as presented, irrespective of one element, to which I am now about to address myself, and in reference to which, I submitted to counsel who argued this question, one or two inquiries, the answers to which then seemed to me, and still seem to me, to be very material, and which I understand are not answered by the report of the master.

526 There is proof in the case that car wheels, annealed in modes known in the history and application of the art, otherwise than by the mode involved in the invention of the plaintiff, have a market value; that they have been sold and used; that they are still sold and used. But upon this subject the proof is not clear or full, nor by any means conclusive. Nor has the master categorically reported upon this particular point.

All this is preliminary, as it regards this view of the subject, and this proposition. If the proof were, that when the wheels were made up to that point—when they are to be subjected to some annealing process—if the proof were that the wheel, at that point, was worthless, had no actual or market value; was worth nothing to the maker, and could not be of any value to him until subjected to the process covered by the plaintiff's patent, then, perhaps, and I use that word upon reflection, then, perhaps, it might be said that if the wheel had no value before being annealed, according to the process of the plaintiff, and after being so annealed, its value involved a particular amount of profit, more or less; perhaps it might be said the entire amount of profit, made by the manufacture of the wheel was due to the process of the plaintiff, and that, therefore, would be the standard and measure for the recovery of damages.

Now the master, as I understand, has not presented the case in this aspect. Irrespective of this particular aspect, we have no hesitation in saying that this is a case proper for the apportionment of damages.

But it seems to us that it might as well be claimed that the plaintiff was entitled to the entire profit of the running-gear, other than the wheel, or upon the entire car, involving the running-gear as well as the body of the car, as the entire profit made upon this wheel.

The master has not reported on this subject; and here it seems there is clearly wanting an element to enable us to arrive at a proper
527 conclusion on this particular point; and as it may possibly come before us hereafter, on the report of the master, I wish here to make one or two additional suggestions. So far as I know, this question is a new one, and I have as yet been unable to come to any conclusion on the subject entirely satisfactory to my own mind. But it would seem to be very clear that if a party invent a machine, or anything else that is perfectly valueless, having no salable commercial value, and in every other respect is worthless because he cannot sell it, and then use in connection with that machine or structure, or article, whatever it may be, the invention of another, no matter how slight that invention may be, which gives it its entire market value, it would seem at first view that the amount to be recovered should be the entire amount of profit, because there is a proximate, inseparable connection between the old, or useless article sold by means of the new invention, which could not have been sold otherwise. In the case of a close monopoly, there is a profit made which would seem at first view, is entirely due to the infringement of the patent-right of another; and it would seem that the infringer ought not to be permitted to say, under such circumstances,

that there should be an apportionment of the profits. But, on the other hand, take the case for instance of a railroad car, or anything else, the making of which involves a large expenditure of money; and then by the application of the invention of another, slight and trifling in its character—of very little cost—of no value, except in connection with that structure, the application of that slight improvement is sufficient to turn the scale in the market, so that nobody will buy the article except in connection with the patented invention. Suppose, in further illustration of this view of the subject, it be a railroad car, the cost of which is thousands of dollars, and some little invention is made in regard to the interior structure of the car, or in its ornamentation, which is patentable under the act of 1861; yet the slight, the simple thing, is such as to strike the public taste and judgment, and have such
528 an effect in the commercial world that nobody will buy the article without that invention; yet it would seem to be a pretty hard measure of justice in a court of equity, to say that the entire profits made on that large article should go into the pockets of the inventor and patentee of this small thing, which had been used without license or authority in connection with it.

I therefore have to remark, as it regards this particular question, we intend to leave the case open. The case must go back to the master for a fuller report upon the general subject, which was adverted to this morning, and discussed this afternoon, in connection with damages, and to which the court has adverted just now. The question must go to the master to take testimony, and report what portion of the profits made by the defendant are due to the use of the invention of the plaintiff by him, without authority; and it may be said further, that this general inquiry would involve a further element relating to the subject. The inquiry may be more specific, to the extent of requiring the master to take testimony, and report whether the wheels were not worth something, without the use of this invention, whether they could have been sold at all. If he finds they could not, then the question to which I have adverted will come before the court for consideration. If he finds there is a sale for wheels not covered by this patent—if he finds the wheels could have been made marketable and salable, though not so salable as if the process of the plaintiff had been used—then he will have to inquire what portion of the profits which the defendant realized is due to the use of the process covered by the plaintiff's patent.

With the case before us, in this single aspect, we shall then be prepared to dispose of this question. Until then, we feel that the question is not ready for us; we shall terminate the argument, and refer the case back to the master, in conformity with the directions just submitted.

529 Mr. STANTON. Your honor has heard argument on but one side. The defendant has not yet been heard on any proposition, except that the report was not sufficient. I suppose I am right in assuming that those points, so clearly stated by your honor for the purpose of inquiry by the master, will be open for discussion before the court, when the master's report again comes in. At that time I expect to be able to show that the case is not one for apportionment—that it is not one for damages in any respect whatever; and that the plaintiff, by having this prohibitory order, has obtained all the relief which, supposing his patent to be valid, he is justly entitled to under the patent law, as administered in the United States. But as the case has very properly gone over for further light, I desire now simply to inquire

whether I am right in assuming that these questions are open, and that the mind of the court is open for judgment upon any point effected by what the master may hereafter report.

Judge SWAYNE. You are right in that view of the subject. We intended to decide nothing, except upon the point that the report must be recommitted to the master, for the taking of further testimony, and for a further report upon these specific points. We do not decide the question as to any amount of profits; neither that we will not give him the total profits, nor that there shall be any apportionment of profits; nor that the plaintiff, when the master's report again comes in, will be entitled to any damages.

Mr. STANTON. Will your honor prepare an order?

Judge SWAYNE. I prefer that counsel should do it.

In the administration of justice in this class of cases, I have found it a saving of time and expense, besides giving specific instructions to the master, to direct that he take testimony and report upon any other subject, according to the direction of counsel in the case on either side.

530 Mr. STANTON. There may be some objections to that in this case. I would make no imputation against the master; he may be fair and honest; I don't know him; and yet I do not think, in view of the magnitude of the interests that may be effected, that it is safe to have many communications between counsel and master except what goes upon record and transpires in the presence of counsel on both sides.

Judge SWAYNE. The suggestion was made only for the convenience of counsel. Of course, whatever occurs with the master will be under the supervision of counsel on both sides.

Mr. FISHER. If either counsel desires testimony on any point not named by the court, it would seem to be proper that these special inquiries be made by the master in connection with counsel, and not privately.

Mr. STANTON. I go further, and submit that the request be made that the court be requested to order such examination to be made, if it sees proper.

Judge SWAYNE. Counsel can either give the master, in the order now to be entered, specific instructions as to points upon which testimony is to be taken, or they may go further, and say that he shall take such further testimony, and report upon the same, as counsel on either side desire; but it does not occur to me that it will be necessary for the master to go beyond the sphere of the suggestions made from the bench.

Mr. STANTON. I suggest that he pause at the point indicated by the court, because I can see no good result in the way of arriving at the ends of justice, by reopening the general matters of fact.

Mr. FISHER. I agree with Mr. Stanton, entirely.

Mr. COLLIER. Propositions which either party may desire to have passed upon, may be submitted.

531 Judge SWAYNE. As my associate on the bench, who heard the case originally, suggests that we do not mean to throw the rein loose on the neck of the master, and let him go where he chooses—we do not want him to go over ground on which he has already gone. The testimony to be sought is additional to the testimony already taken, and on a point not already reported upon.

532 United States circuit court.

[Entered October 22, 1868.]

ASA WHITNEY
vs. } 534.
ALBERT L. MOWRY.

This cause came on to be heard upon the reports of the master, and the exceptions thereto, and was argued by the counsel of the respective parties; whereupon it is ordered by the court: That the said master take further testimony, and report to the court what proportion, if any, of the profit made by the said defendant was due to the use, by him, of the complainant's invention, and that, in connection with this subject, he report:

First. Whether the wheels made and sold by the defendant had, or could have been made to have, any market value without being subjected to the process patented to the complainant.

Second. If they had, or could have been made to have, such value, by any annealing or slow-cooling process outside of the complainant's patent, how much additional and greater market value, if any, they derived from being subjected to said patented process.

It is further ordered, that said testimony shall be taken within sixty days from the time of the entry of this order; that the said master shall file his report within forty days thereafter, and that either party may file exceptions within thirty days thereafter. And this cause is
533 continued.

Circuit court of the United States, southern district of Ohio. In equity.

ASA WHITNEY
vs. } 534.
ALBERT L. MOWRY.

Before Geo. R. Sage, special master.

Depositions of witnesses taken before the master at his office, No. 2 Masonic Temple, Cincinnati, Ohio, October 29th, 1868, in pursuance of the notice hereto attached, and on behalf of the defendant.

Present, the defendant in person and Charles B. Collier, of his counsel, and Jas. Moore for S. S. Fisher, of counsel for complainant.

WILLIAM CULLEN, being solemnly sworn, deposes and says:

Question by C. B. Collier. Where do you reside, and what is your occupation?

Answer. At Cincinnati, and I am master mechanic Cincinnati, Hamilton and Dayton, and Dayton and Michigan Railroads, and have occupied that position about eight years.

Ques. 2. Were you connected with the road before you became master mechanic; if so, in what capacity, and how long have you been connected with it?

534 Ans. I was connected with the roads about seven and a half years before I became master mechanic, as foreman of the shops.

Ques. 3. What has been the sphere of your duties as master mechanic and foreman of the shops?

Ans. As master mechanic, I had charge of all the rolling stock belonging to the roads; cars, locomotives, and all the rolling stock, as it were, connected with the roads, and machinery; as foreman of the shops, to attend to the details of the work, giving the work to the men, and seeing that it was done properly.

Ques. 4. State, if you know, whether there was purchased and used on your roads, from A. L. Mowry, car wheels—cast-iron car wheels—before the use of the charcoal process by him, that is, prior to 1861.

Ans. Certainly; we bought wheels from Mr. Mowry prior to 1861; I should say, as near as I can recollect, we bought wheels from Mr. Mowry in 1853; that was when I first commenced with the road.

Ques. 5. State whether or not there have been purchased from A. L. Mowry and used on your road, cast-iron car wheels made by him by the use of his charcoal process since 1861.

Ans. Yes, sir; I believe as far as I know, there have.

Ques. 6. State, if you know, what was the quality and character as to wear and durability of the wheels manufactured by Mr. Mowry, and used on your road prior to 1861.

Ans. I don't know that I can tell exactly about the wear of the wheels, that is, as to the number of miles run, but the way I look at it, the wheels we bought then were as good as any we have bought since.

Ques. 7. Have you purchased wheels from Mr. Mowry since April, '67, and are you now purchasing wheels from him?

Ans. Yes, sir.

535 Ques. 8. State, if you know, whether there has been any change in the form or weight of wheels purchased for your road from Mr. Mowry since you commenced purchasing and using his wheels, or since your connection with the roads.

Ans. Not anything particularly to my knowledge; there has been no change that I have noticed.

Ques. 9. State, if you know, whether there has been any difference or is any difference, in the market value of wheels made by the use of the charcoal process, and without the use of the charcoal process; if so, state what that diference is.

Ans. I don't know that there is any difference, or has been.

Question by the master. Please state whether the wheels purchased from Mr. Mowry, and which were manufactured by the use of the charcoal process, were of uniform quality.

Ans. So far as I know, they were.

WM. CULLEN.

Also came JERRY O. DONNELL, who being first solemnly sworn, deposeth and saith:

Question 1 by complainant's counsel. Please state your residence and occupation.

Answer. I reside at No. 12 East Sixth Street, Cincinnati, O.; I am book-keeper for the firm of John Nash & Co., car-wheel manufacturers, Cincinnati.

Ques. 2. How long have you been in their employment as book-keeper?

Ans. Since January, '67.

536 Ques. 3. Were you in their employment before then; if so, in what capacity, and for how long?

Ans. I was, sir; I worked in their foundry six or seven years; moulding is my trade since 1850, but since 1866 I have not been able, physically, to work at the business.

Ques. 4. State, if you know, by what process, if any, John Nash is now manufacturing car wheels, that is as to the process of cooling or annealing the wheel.

Ans. Well, sir, they just simply put them in a pit, one wheel over another, use no fuel of any kind, just the heat of the wheel and a little sand.

Ques. 5. For how long has he been cooling them in this way?

Ans. Well, sir, since some time in April—about the middle or latter part of April, 1868—since Mr. Baldwin notified them that they were infringing Whitney's patent, they stopped burning charcoal, or using any kind of fuel to reheat them.

Ques. 6. State whether or not the wheels cooled in the manner as now practised by Mr. Nash and described by you, have any market value.

Ans. Well, they are of about the same market value as where they used charcoal; they are getting the same prices for wheels cooled without the use of fuel as they did in September and October last, for the wheels that were annealed with charcoal.

Ques. 7. Has any change been made in the form or weight of wheels manufactured by Nash since the discontinuance of the use of charcoal?

Ans. No, sir; not a particle. They use the same patterns, and the wheels are of the same weight and dimensions, and there has been no change whatever.

537 Ques. 8. What difference, if any, has there been, and is there, in the demand and salability of the wheels made with the use and without the use of charcoal?

Ans. Well, sir, there is no difference. We have the same demand that we had for wheels last January and all last year. In fact, we have more demand now, and are making more wheels now than we did then.

By the master:

Suppose wheels were cast in your moulds or in any of the moulds now in use, and not subjected to any process of slow-cooling or annealing, or in other words were suffered to cool in the open air, what would be their market value as car wheels?

Answer. They would be of no account, sir. You wouldn't find one in fifty that would stand; they would all burst or crack if suffered to cool in the open air on account of uneven contraction.

Ques. 2. What would be their value for any purpose?

Ans. They would be worth just what the iron in them would be worth for remelting.

JERRY O. DONNELL.
289 *East Pearl.*

Adjourned until 2 o'clock p. m.

JAMES LAMB being first solemnly sworn, deposes and says:

Question 1 by complainant's counsel. Please state your residence and occupation.

Answer. My residence is Cincinnati; I am not now engaged in any business. For eleven and a half years prior to this time, I have been connected with the Little Miami Railroad, being in charge of repairs of cars, repairs of buildings, and for the last five years have
538 been the purchase and supply agent of the road. I terminated my connection with the road in October, '68. In the former part of my connection with the road, I was the acting supply agent of the road, and was so nearly all the time, excepting only at intervals.

Ques. 2. During the time that you have been supply agent and acting supply agent for said company, have you made purchases both of annealed or reheated, and unannealed or slow-cooled cast-iron car wheels?

Ans. Yes, I have purchased both kinds.

Ques. 3. What, if any, has been the difference in the market value of the two kinds of wheels?

Ans. Well, in June, '66 —I think about that time—I could have bought the annealed wheels in town here at $22, and I bought the other class of wheel in Cleveland in preference at $23 50; they were single plate—much lighter wheel. The Cincinnati wheel was a double-plate wheel. We had a good deal of trouble with the annealed wheels at the time we made the change.

Ques. 4. Why did you prefer the unannealed wheel of which you have spoken?

Ans. My experience when I first went to the Little Miami Railroad was with the unannealed wheel, and I thought then the wheels were much better than they were at the time I made the change. I went up to see the Cleveland wheels, and liked them better in every respect than the wheels here, and from my former experience with that class of wheels, I thought I was justified in taking them.

Ques. 5. Was the Cleveland wheel a straight or curved wheel?

Ans. It was a single plate; I don't remember the shape; I never paid much attention to the shape. I was more interested in the wear;
539 I think it was a little different shape from the Whitney wheels, but I did not pay much attention to the shape; there are so many styles of wheels that it is impossible to keep the run of all of them.

Ques. 6. How has the Cleveland single-plate unannealed wheel proved as to wear?

Ans. Well, the first we got were good wheels; they wore well in every particular; the last were not as good, and I have recommended a change.

Ques. 7. Have you purchased and used any wheels made by Asa Whitney & Sons, in Philadelphia; if so, when?

Ans. I don't think I purchased any from Whitney & Sons; unless I took up my books, I could not remember.

Ques. 8. How about using them?

Ans. I have had some experience in using them.

Ques. 9. When?

Ans. About the commencement of my career with the Little Miami Railroad we used a good many of them, and they came under my attention.

Ques. 10. State what has been the market value, the wear and durability of said wheels as compared with the unannealed, or slow-cooled wheels, so far as known to or observed by you.

Ans. Not having bought any of the Whitney wheels, I could not know the market value of them. We were guided rather by the quality than the price; we would rather have given more by two or three dollars for a good wheel. I always thought the quality of the wheel was more from the quality of the iron, because sometimes we had wheels so much better than at other times, from different manufacturers. I watched closely the running of the wheels, and I used to keep an account of the mileage. I have noticed that when I first had control of the wheels, I didn't have occasion to complain as much of them as after they commenced to anneal them. The first Whitney wheels on our road were good wheels; they were as good wheels as we have ever
540 used, and the last of them were about as bad as we ever used;

we couldn't press on the axles, the last we had, they would break under the pressure. These little incidents led me to think that there must be something in the iron, if the process is always applied in the same way, and I have always contended there must be something wrong in the material they have used, and that there was not as much in the process.

Cross-examination by S. S. Fisher.

Question 1. Please state the process by which the Cleveland wheels were manufactured.

Answer I just understood that they were not the annealed wheels—that they were manufactured in the old fashioned way. I never entered into the detail of their processes.

Ques. 2. Then you have no personal knowledge as to the process by which they were manufactured?

Ans. Well, I couldn't exactly say that, but I didn't go into the detail. I didn't consider it my business to go into the detail. I simply was guided by the quality of the wheel.

Ques. 3. Do you know of your own knowledge, whether those Cleveland wheels were or were not subjected to some process of annealing?

Ans. I went through the place with Mr. Smith, and he told me they were not annealed. We had some talk about the way in which they were made, but I didn't care to investigate the process of manufacture; I only looked to the quality of the wheel, and I didn't care how it was made. I could tell it was a good wheel, and I could tell that the last he sent us were bad wheels; I could tell just by looking at them, and my observations were verified by my experience with the wheels.

Ques. 4. Do you know of your own knowledge, &c. (Question 3 repeated.)

541 Ans. All I know is what Mr. Smith told me. I am guided by the quality of the iron, the appearance, smoothness, finish, &c., by which I can very soon find out whether a wheel is a good or a bad wheel.

Ques. 5. When you speak of annealed and unannealed wheels, I understand you to say that you do not, of your own knowledge, know by what process either of those were manufactured. Am I right?

Ans. I have always considered the annealed wheel more liable to flatten from the creases. I do not understand how it is caused, but I have never observed the same peculiarity in wheels made by the other process. I understand there are three processes: one by sand, one by heat, and another by charcoal; but the details of the processes I have never looked into.

Ques. 6. Which of these processes do you call annealing, and which unannealing?

Ans. The charcoal is the annealing.

Ques. 7. What is the heat process called; is that annealing or unannealing?

Ans. I suppose you would call it annealing. I don't know much about the processes.

Ques. 8. What do you call the sand process; do you call it annealing or unannealing?

Ans. They call it a cooling process. I don't know much about it.

Ques. 9. How is the sand applied?

Ans. I could not tell. I never saw it.

Ques. 10. Is it hot or cold?

Ans. I never saw it. The wheel must make it hot, and gradually cool down.

542 Ques. 11. Is the sand hot when applied to the wheel, or cold?
Ans. I could not answer that.

Ques. 12. Then, except that certain wheels were called annealed or unannealed by the parties from whom you bought them, you really know nothing of the manner in which those wheels were made?

Ans. I know by what they said how they were made, because I inquired. I understood that the Mowry and the Nash wheel were made by the charcoal process until lately, and I understood that the Whitney was made by the hot-air process, and the Cleveland by the sand process. As I had a good opportunity to break and test those wheels, I detected what I considered the best for our use. I found that the sand wheel had the best chill on it.

Ques. 13. What were the advantages of the annealed wheel?

Ans. I have seen some very good, tough wheels from the annealed. I have seen such a difference in the different wheels that I think that the strength was more in the quality of iron used than in the process.

Ques. 14. When did your acquaintance with car wheels manufactured by any process begin?

Ans. About eleven years and a half ago.

Ques. 15. Then when you speak of wheels made by the "old-fashioned way," you do not refer to anything in your own knowledge more than twelve years old?

Ans. No; I do not.

Reëxamination:

Question 1. By whom were the Cleveland wheels, referred to by you, manufactured?

Ans. By the Fulton Company.

JAMES LAMB.

543 Examination of WILLIAM CLOUGH, by Cha's B. Collier, defendant's counsel:

Question 1. Have you at any time manufactured, or caused to be manufactured, cast-iron car wheels; if so, when and where?

Answer. Yes, in the city of Madison, Indiana, commencing in 1851.

Ques. 2. How were those wheels annealed, if at all?

Ans. At first by being covered with a mass of dry sand, and left on the foundry floor until the heat had slowly escaped. Afterward the wheels were annealed by being put into pits and covered with dry sand, a current of cold air being caused to circulate through the eyes of the hubs to accelerate the cooling of the heavy mass of metal composing the hub.

Ques. 3. What was the effect upon the wheels manufactured by each of the processes described by you as to producing a good wheel or otherwise?

Ans. The effect in both cases was to equalize or accommodate the contraction of the metal in cooling, and prevent the occurrence of an inherent strain, which, if allowed, would impair the usefulness of the wheel. I have had made for my use some thousands of car wheels.

Ques. 4. How did such wheels wear, and were they marketable and salable, or otherwise?

Ans. They were good wheels. I have always given them the preference over wheels annealed by other processes employed at the time.

Ques. 5. By what name, if any, was the process last described by you, that is, passing cold air through the hubs of the wheels, known?

Ans. It was known as Murphy's process of annealing car wheels.

544 Ques. 6. Was it patented?

Ans. It was.

Ques. 7. State, if you know, the comparative market value, then and since, of wheels manufactured by either of the processes described by you and wheels subjected to the reheating process patented by Asa Whitney.

Ans. The market value, never in my experience, was understood to turn upon, or be changed by, the peculiar process of annealing. Manufacturers commended their wheels by alleged advantages obtained by their peculiar process of annealing, but their prices did not vary with reference to said process of annealing. They did vary with regard to weight and pattern.

Cross-examined by S. S. Fisher:

Question 1. What was the configuration of the wheel subjected to this process?

Ans. They were plate wheels, usually the Washburne pattern, which consists of the double plate around the hub, uniting in a single plate half way between the hub and rim, with false spokes or brackets on the single plate.

Reëxamination by defendant's counsel:

Question 1. What, if any, were the advantages to the wheel by reason of its peculiar configuration, which you have described?

Answer. Understanding the question to refer to the Washburne wheel, the advantages claimed by that wheel, and I think correctly, are that it is well supported at the hub and under the tread; the arrangement of the plates and brackets affording strength, and the form which they assume in the wheel accommodates the contraction of the metal in cooling, measurably.

Ques. 2. Do you know the form of wheels that have been man-
545 ufactured by A. L. Mowry? If so, state whether the wheels so made by him were like or unlike the wheels manufactured by you as described?

Ans. Some of them have been the same; others have been very nearly like those described, differing in the dispensing with the brackets or false spokes, and increasing the thickness of the plate.

W'M CLOUGH.

Adjourned until Friday morning, October 30th, at 11 o'clock.

FRIDAY MORNING, *October 30th*—11 *o'clock.*

Present, Charles B. Collier, of counsel for defendant, and S. S. Fisher, of counsel for complainant.

ALVIN A. STONE, being first solemnly sworn, deposes and says:

Question 1 by counsel for defendant. Where do you reside, and what is and has been your business?

Answer. I reside in the Seventeenth ward, Cincinnati. I am a master mechanic for the Little Miami Road now, and have been employed in similar situations for fourteen years, on various roads.

Ques. 2, Have you been connected during said time with any other road? If so, what roads?

Ans. Hartford and New Haven, and Springfield Roads, in Massachusetts and Connecticut, from '49 to '55; from '55 to '64 on the Milwaukee and Chicago; from June, '64, to July, '68, on the Marietta and Cincinnati, and the remainder of the time on the Little Miami.

Ques. 3. Have you, during such period—and if so, when—had experience in the use of cast-iron car wheels manufactured by Asa Whitney & Sons, of Philadelphia?

546 Ans. I think it was in '51 and '52 we used the Whitney wheel on the Hartford Road; and since then I haven't ordered any wheels from Whitney. All the experience I have had is of wheels that have come under new engines from different builders.

Ques. 4. What was the form and configuration of the wheels made by Whitney & Sons, and used by you?

Ans. The wheels used in '51 and '52 were a corrugated single plate wheel; those used since that time were a straight single plate wheel.

Ques. 5. What is the result of your experience and observation in the use of said wheels, as to their wear and durability?

Ans. My experience of the Whitney wheels has not been favorable. I consider them a poor wheel, so far as wear and durability is concerned.

Ques. 6. Have you, during said period, seen cast-iron car wheels cooled by being covered in pits or with sand, without heat being applied to reheat them; and if so, have you used, or seen in use, such wheels? and if so, state time and place.

Ans. Yes, I have seen them, and been using them all the time. I have seen them made—have been in where they were making them—at Nash's and Mowry's; was at Blanchard & Arnold's in Milwaukee; at Russell & Co's, at Chicago; and at the shops of the Marietta & Cincinnati Road, at Zaleski. From 1855 to the present time will cover the dates.

Ques. 7. What is the result of your experience and observation, as to the wear and durability and market value of the wheels cooled in the manner last above described, as compared with the wear and durability and market value of the wheels made by Asa Whitney & Sons?

Ans. My experience with the Whitney wheel—what I have had—has not been more than half as long as other makes. From the expe-

547 rience I have had, I wouldn't pay more than two-thirds as much for the Whitney wheel as I would for some other wheels. As to the market value, I don't know how they compare with other wheels. I never had any Whitney wheels that wore over two-thirds what other wheels, that were right alongside of them, wore—I mean, to take them as a lot together.

(Counsel for complainant objects to the statement by the witness of what he would have given for the wheels, as not responsive to the question.)

Ques. 8. Have you seen single-plate wheels cooled in the manner last above-described—that is, by being pitted or covered with hot sand?

Ans. I have seen wheels that I was told were cooled in that way; I never saw them cooled.

Cross-examined by S. S. Fisher.

Ques. 1. Have you used wheels manufactured by A. L. Mowry during the years 1862, '63, '64, '65, and '66?

Ans. I have.

Ques. 2. How did those wheels compare, as to wear and durability, with those made by Whitney?

Ans. Well, I considered them a little better wheel than the Whitney wheel.

Ques. 3. If they were made by the same process, upon what do you suppose their superiority to depend?

Ans. By their using better material in the manufacture.

Ques. 4. May not that have been the reason for what you suppose to have been the superiority of the other wheels of which you have testified?

Ans. Yes, it may.

Ques. 5. How many Whitney wheels have you used in such a manner, and to such an extent, as to have formed an opinion of their durability?

548 Ans. Well, when we first commenced using them we must have used twenty or thirty a month; that was in the years '51 and '52, or '52 and '53; that is my recollection, and since then until '64, I don't remember of using any. In '64 we had four engines with twelve wheels under each engine, and last year there was four engines, with four wheels under each engine; the engines came on to the Little Miami road about a year ago, and there is only one pair running now.

Ques. 6. Where were the wheels used in '51 and '52 or '52 and '53, of which you spoke in your last answer?

Ans. On the Hartford, New Haven and Springfield Road.

Ques. 7. What other wheels were used on that road?

Ans. After we abandoned the Whitney wheel we used the Washburne wheel, made by Washburne.

Ques. 8 When did you leave the New Haven and Hartford and Springfield Road?

Ans. January or February, 1865. February, I think it was; the first of February.

Ques. 9. When was the Washburne wheel introduced on that road, and to what extent, before you left?

Ans. I am not certain, but I think it was introduced in 1853. It was soon after they commenced making them. All the wheels used the remainder of my time there, were of that pattern or make.

Ques. 10. State, if you know, by what process the Washburne wheels were manufactured.

Ans. I don't know, not of my own knowledge; I don't know.

Ques. 11. Was the Washburne a single or double plate wheel?

Ans. Double plate.

549 Ques. 12. Then on the New Haven, Hartford and Springfield Road you had no single-plate wheel to compare with Whitney's, had you?

Ans. No, sir.

Ques. 13. Your late experience with the Whitney wheel, if I understand you, is confined to four engines having twelve wheels each, and four having four wheels each, or sixty-four wheels in all; am I right?

Ans. Yes, sir.

Ques. 14. By whom were the wheels manufactured upon the other engines and tenders, that you compared with these Whitney wheels?

Ans. Wheels were made by Lobdell & Co., John Nash, and Mowry, is all I think of; yes, Blanchard & Arnold.

Ques. 15. Have you any personal knowledge of the process by which wheels, referred to in your last answer, were made?

Ans. No, sir; except the Blanchard & Arnold wheel; I know how those were made?

Ques. 16. Will the books of the repair shop of the Marietta and Little Miami Roads show how frequently the wheels of these engines have been replaced?

Ans. Yes, sir; I expect they will.

Ques. 17. What have been the average duration of those Whitney wheels on those engines, or of those sixty-four Whitney wheels?

Ans. About one year, I should judge; I can't tell that exactly without referring to the books.

Ques. 18. What has been the average duration of the wheels on the other engines named in answer to question No. 14?

Ans. My impression is, about eighteen months; that would be a general average.

550 Ques. 19. Were they not all double-plate wheels?

Ans. Yes, double-plate or spoke.

Ques. 20. What was the diameter of them?

Ans. Twenty-six and twenty-eight inches.

Ques. 21. What the weight?

Ans. I can't tell the weight.

Ques. 22. What were the names of the engines whose wheels you compared with Whitney, as to wear and durability.

Ans. On the Marietta Road, the Noah L. Wilson, John Durand, W'm T. McClintock, D. A. Schoter, David Gibson, Beman Galis, John Waddle, E. H. Moore, A. B. Waters, Samuel B. Keys, and John Ballard; Francis J. Haseltine, Robert Benson, Ferguson, (I have forgotten the initials,) Alphonso Taft, Jonathan Niles, and others. These all used 26 and 28-inch wheels, double-plate or spoke.

Ques. 23. What were the names of the eight engines that used the Whitney wheel, and to what road or roads do they belong?

Ans. W. P. Roclefson, W'm Glenn, M. Scott Coole, and Abraham Hegler, on the Marietta Road; and the O. S. Pease, John Durand, B. F. Strader, N. L. Anderson, and H. C. Noble.

Reëxamination:

Question 1. Is not the Washburne wheel a double and single plate combined—that is, a double plate around the axle, connecting with the tread by a single plate?

Answer. Yes, sir.

Ques. 2. What advantages, if any, pertain to wheels of this pattern?

Ans. Well, I don't know of any particular advantage. They claim to make a stronger wheel, but that is a question.

551 By the master:

Ques. In answer to question 7, you speak of the comparative wear of the Whitney and other wheels when used side by side. Please state, if you please, in what the difference consists?

Ans. In the uneven chill of the Whitney wheel.

A. A. STONE.

C. B. COLLIER, being first solemnly sworn, says:

I am subscribing witness to the paper now produced and offered in evidence, purporting to be a license or partial assignment from George Keck to Albert L. Mowry, of letters-patent, granted on the 8th day of October, A. D. 1850, to Nathan Washburne, for improvements in the manufacture of car wheels. I drew the instrument; saw Mr. Keck sign it and deliver it to Mr. Mowry.

CHA'S B. COLLIER.

Also came ALBERT L. MOWRY, hereinbefore sworn by the master, and deposes and says:

George Keck is at Louisville, Ky., or some place down the river. I think I have had the original deed of assignment to George Keck, fro

Washburne, of the patent referred to in Mr. Collier's testimony. It was given to me by Mr. Keck; where it is now, I do not know. The assignment was given to me for a valuable consideration; it was this: I was to give him 10 or 12 per cent. of the profits of my business for three years—that was the consideration of the assignment. Mr. Atwood brought suit against me for an infringement of his patent. It was in court several years. I finally settled with him and bought
552 a right for Cincinnati and St. Louis, for which I paid him $2,000 for the Cincinnati shop-right, and $1,000 for the St. Louis; that was in final settlement of that suit—he agreeing to have the suit dismissed at his costs. The deed from Atwood to me I have in my hands; (offered in evidence by Mr. Collier;) it was delivered to me by Mr. Atwood.

A. L. MOWRY.

Adjourned to October 31st, at 10 o'clock a. m.

SATURDAY, *October 31st, at half-past 10 a. m.*

Present, C. B. Collier, for defendant, and S. S. Fisher for complainant.

SAMUEL FIRST, hereinbefore sworn, deposes and says:

By counsel for defendant:

Question 1. Since the discontinuance by Mr. Mowry of the charcoal process, and the use of the slow-cooling process simply, what has been the demand for sale of, and market value of his wheels, as compared with the demand for sale of and market value of wheels made by the use of the charcoal process?

Answer. Well, the market value has been depreciated from the fluctuations of prices of material and labor; material has declined in price and also labor; the comparative demand for the year 1867 was not as great as it was formerly, that is, as it was during the years 1863, 1864, and 1865.

Ques. 2. Well, how has it been in the year 1868?

Ans. Well, the demand has been greater in 1868 than at any time since the years 1863 and '64; the works are now manufacturing thirty-six wheels per day, and have orders to fill in advance, of some seventy-five wheels, and twenty-six (and ten are thirty-six and five are) forty-one railroad cars, which require eight wheels to a car.

553 Ques. 3 Will you state the number of wheels manufactured and sold by Mr. Mowry from December, 1851, to 1861, as shown by the books of the defendant, stating the kind of wheels so made, and the average prices obtained therefor or received therefor?

Ans. I have made out, from the books of Mr. Mowry, a statement, which is not yet quite complete; but when completed it will embody the facts called for by the question. The statement is made accurately and fully, and is in all respects correct. I will complete it, and then submit it to the master, and desire that it be attached to my deposition, as part thereof.

Cross-examined by S. S. Fisher:

Ques. 1. Will you make out a similar statement for the years 1867 and '68—since the service of the injunction, and up to the present time, and annex it to this deposition?

Ans. I will.

Ques. 2. What was the price paid for labor during the months of September and October, 1868?

Ans. For moulders, $3 per day; pit men, $1 66⅔ per day; cupola tenders, $2 50 per day.

Ques. 3. What have you paid for materials during the same time?

Ans. We have paid from $33 to $60 per ton; we have purchased old wheels at $35 per ton; cold-blast car wheel iron from $43 50 to $60 per ton, and hot-blast iron for $33; but this last is not used for car wheels, and the first figures, or $33, above, should be $35.

Ques. 4. What have been the prices at which you have sold wheels during the same time?

554 Ans. The prices have been, for 33-inch car wheels, $18 and $19 per wheel, according to the difference between the narrow tread and compromise wheel. For 30-inch wheels our price has been $17 per wheel. We have sold a few street-car wheels at $18 50 per wheel—30-inch wheel.

Ques. 5. What is the reason of the difference in the price of cold-blast iron during those two months—does it result from fluctuations in prices, or from different brands and qualities?

Ans. It results from the different brands of iron—Lake Superior being sold at the lowest price, and Hanging Rock at the highest.

By the master. Please describe the process of cooling used by Mr. Mowry in the manufacture of car wheels since the injunction in this cause.

Ans. The wheels are taken from the chills or moulds as soon as they can be moved, and while they are yet at a red heat, and placed in the pits, and the pits are covered as nearly air-tight as they can be with a cast-iron plate, the cracks being luted with clay or mortar, and the wheels are suffered to remain there until they become cool. There is no sand in the pits, that I know of.

SAMUEL FIRST.

Adjourned until Monday, November 2d—at 11 a. m.

MONDAY, *November 2d—2 p. m.*

JERRY O. DONNELL appeared for cross-examination:

Question by S. S. Fisher, of counsel for complainant. How many wheels per day are John Nash & Co. now manufacturing?

Ans. They are making twenty-six now, at the present time, sir; about twenty-two or twenty-three 33-inch, and the other three or four, 28 and and 30 inch wheels.

555 Ques. 2. Is the number greater or less than the average manufacture for the last three months?

Ans. Well, it is about the same. We have been manufacturing about the same number for the last three months, or five or six months.

Ques. 3. What was the average daily manufacture during 1867 and the first half of 1868?

Ans. Well, sir, the average was from twenty to twenty-six per day the latter part of 1867 and the first six months of 1868; twenty is the lowest and twenty-six the highest. We haven't capacity for over twenty-six. And further the witness saith not.

JERRY O. DONNELL.

556 U. S. circuit court, southern district of Ohio.

ASA WHITNEY
vs.
ALBERT L. MOWRY.

Chas. B. Collier, appeared for defendant; Henry Baldwin, jr., appeared for plaintiff.

DAVID P. GREEN, a witness produced on the part of the defendant, being by me first duly sworn to tell the truth, the whole truth, and nothing but the truth, deposes and says:

Question. Where do you reside?

Answer. In Arlington, Massachusetts.

Ques. Where have you resided heretofore, and what has been your occupation?

Ans. I have resided in St. Louis, and have been in the foundry business.

Ques. What have you manufactured?

Ans. Car wheels, car castings, locomotive and all kind of railroad castings.

Ques. During what time did you manufacture the articles specified in your last answer?

Ans. Since 1857 up to the present time.

557 Ques. How extensively?

Ans. On an average, a business of thirty or forty thousand dollars a year.

Ques. By what means, if any, have you cooled car wheels made by you?

Ans. From the time I commenced, up to 1863 or 1864, I cooled them in sand, by covering them. From that time, some of the time I have not used sand, but have put them in a pit. I have used charcoal to see if it would make them any better. Sometimes we would use it for a few days, and then we would stop. After ceasing to use the charcoal, we put them in pits and covered them up.

Ques. What difference, if any, was there in the market value of wheels made by you and cooled in sand, and those made and cooled with the use of charcoal?

Ans. No difference at all.

Ques. To whom did you sell wheels?

Ans. We used to sell them to the Northern Missouri Railroad, and to the Ohio and Mississippi Railroad. Have sold some to almost all the railroads.

Ques. What difference, if any, was there in the demand for wheels, by reason of the use of charcoal?

Ans. I never found any difference.

Ques. Do you know of wheels having been made by other manufacturers in St. Louis, and cooled in sand at the time you were using charcoal; if so, by whom?

Ans. I saw H. M. Woodward's wheels in the sand; never saw him use charcoal.

Ques. State, if you know, the comparative market value of the wheels so made by Mr. Woodward, and the wheels made at the same time by you, with the use of charcoal.

558 (Objected to by plaintiff's counsel, the witness only having

testified that he had used charcoal to see if it would make them any better.)

Ans. I used always to have to sell them at the same price that he did.

Ques. Are you still manufacturing car wheels?

Ans. Yes.

Ques. How are they cooled?

Ans. By being laid in pits, without any fuel.

Ques. To whom do you sell such wheels?

Ans. Iron Mountain Railroad, the Pacific Railroad, and the Northern Missouri Railroad, and the Ohio and Mississippi.

Cross-examined:

Ques. Where do you now make car wheels?

Ans. In St. Louis.

Ques. What is, and has been your business style and firm?

Ans. It was at first A. L. Mowry & Co., then changed to the St. Louis Car Wheel Company; then to D. P. Green & Co.

Ques. Was said A. L. Mowry this defendant?

Ans. Yes.

Ques. Is he still a member of your firm, or interested in your business?

Ans. No; he is not.

Ques. Since when has he been out of your business?

Ans. I think, to the best of my recollection, it was somewhere about 1863 or 1864.

Ques. Is he a relative or connection of yours?

Ans. Brother-in-law.

559 Ques. Since 1863 or 1864, how many car wheels have you made or caused to be made at St. Louis, or elsewhere?

Ans. I could not give a definite number.

Ques. State, as nearly as you can, the number per day, and the number per year, each year since you have been in the business.

Ans. I do not think that in 1857 we made eight a day. For two or three months, perhaps, they might make eight a day, and then stop and commence again; never made more than eight a day that year; could not tell how many days we made eight a day. In 1858 or 1859, I could not recollect which year, we made 16 a day, for nearly three months. In 1860—I cannot recollect—we did a very light business that year, and also in 1861; do not know that we made any wheels for one or two years; we might have made a few; in 1862, to the best of my recollection, we did not make a great many wheels that year. In 1863, it was about the same thing as in 1862; it has been so right along from that year up to the first of June or July, 1868; since then have been making from eight to twelve every day, and make that number now.

Ques. Was your manufacture of wheels the leading feature of your foundry business, or did you make wheels only upon orders prior to June or July, 1868?

Ans. It was not my leading business; only made wheels upon orders; as we got small orders, we would make them to order.

Ques. You made them, then, in job lots, as other foundry castings?

Ans. Yes.

Ques. Did you make, at any time, any car wheels which were cooled without being put in pits?

Ans. When I first commenced, I used to cover them with sand; now I make them by putting them in pits and covering them up.

560 Ques. When you covered them with sand, what did you put them in?

Ans. I put them in cans and covered them with sand.

Ques. Describe these cans.

Ans. These cans are a round ring about 2 feet deep, and 36 or 38 inches diameter; cans were made of sheet iron. We used to put the wheels in these cans, and then cover them with sand.

Ques. What did you put them in the cans and cover them with sand for?

Ans. So as to let them gradually cool off.

Ques. Was that necessary?

Ans. I did not try the experiment to see whether it would do or not; I have seen wheels made and laid in the open air without being canned.

Ques. What experiments did you mean you did not try, in your last answer?

Ans. That was leaving them out in the open air without being canned.

Ques. Were the wheels red hot when you canned them?

Ans. When we first began to shake them out from the moulds they would be red hot; sometimes towards the last end they would begin to turn a little black.

Ques. Did you aim to get them into the cans as soon as possible after they were cast?

Ans. After they got cooled sufficiently to take them out, we did.

Ques. Of the wheels cooled in this way, did any crack in cooling?

Ans. Very seldom; to the best of my recollection I never had any crack.

561 Ques. You say you have seen wheels left to cool in the open air; where was that and when?

Ans. That was at George Sizer's foundry, at Springfield, Massachusetts. To the best of my recollection, it was in 1847.

Ques. Have you ever seen it done anywhere else?

Ans. I have never seen it done anywhere else.

Ques. In using charcoal did you follow the plan patented to Mr. Mowry in 1861?

Ans. I expect I did not altogether. I did not use charcoal as he did altogether.

Ques. Did you use the charcoal process otherwise than experimentally?

Ans. No; I did not.

Ques. Did you sell any wheels that you made in experimenting with that process?

Ans. Yes; I did.

Ques. Did you hear any complaints about them?

Ans. I had a good many wheels thrown back on my hands of those that I made in that way.

Ques. In filling orders for wheels, what was the understanding between your customer and yourself as to how they were to be made?

Ans. There was no understanding about it, only they wanted them well chilled, so they would stand. We always warranted them for a year; that is customary in all wheel business.

Ques. What was the price of a 33-inch wheel in 1857, 1858, and 1859?

Ans. I think a 33 inch wheel in 1857, to best of my recollec-
562 tion, was from sixteen dollars to sixteen and a half dollars. In 1858 it was same, and up to 1859, and then I think it was a little less. The price of wheels varied with the price of iron and the price of labor.

Ques. Did you abandon the use of charcoal because of the wheels coming back on you?

Ans. We had to abandon charcoal because it drew the chill. It warped them when we first tried the experiment.

Ques. Did you ever try the charcoal process, employing the means described in A. L. Mowry's patent of 1861?

Ans. We were never fixed to try it the same as he had it. He had some little things about the pit which we had not, if I recollect aright. I never saw the patent.

Ques. Have you ever seen his cooling apparatus at his car-wheel foundry in Cincinnati?

Ans. I have seen the pits where he cools the car wheels.

Ques. Do you understand his charcoal process, as practised by him at Cincinnati?

Ans. I have seen him using it there, but how he used it I could not tell.

Ques. In selling your car wheels, have you regulated your price by the market price, or by your own views of business profit?

Ans. By the market price, which we are always governed by.

Ques. Then you would make wheels upon orders and sell them at the market price, without regard to the per cent. of profit?

(Objected to by defendant's counsel as improper in form.)

Ans. We are always goverened by the market price of iron and labor, and the competition we had to contend with.

563 Ques. If a railroad wanted a lot of wheels, you contracted to make them at the market price, whether your profit would or would not be as great as that of competing manufactories; is not that so?

Ans. Not always. We would not sell them at too low a figure, of course. If it was less than we could buy the iron and make them, we would let the job go. I have known instances where we have let the job go by, and have not made the wheels.

Ques. In what sense do you use the term market value of a car wheel?

Ans. That depends on the price of iron and labor at the time you are making the contract.

Ques. Then you mean the cost and not the selling price, when you say market value?

Ans. I am always governed by the price of iron, what it can be bought for, and how cheap I can make them. There are some cases where you make them at a very small profit.

Ques. What compensates for the reduction of profit in such cases?

Ans. In some cases it would be better to make them at 50 cents profit than to lose the job. It might throw other work in your way, so you could make it up. You might sometimes get a job where you would make $2 a wheel, and at another time you might take it at 50 cents profit, by getting other work with it.

Ques. Do you regard the market value of the wheels which you made by the charcoal process, and had thrown back on your hands, the same either to your customers or to yourself as the wheels made by the sand process, which fulfilled your warranty?

564 Ans. It was a damage to have wheels thrown back on my hands in that way.

Ques. If a wheel failed in use, and is thrown back on your hands, is it worth to you any more than its weight as iron?

Ans. That is all that it is worth.

Ques. Is it worth any more than that to a railroad?

Ans. It is only worth the price of scrap iron to them. They *they* have to turn it into scrap.

Ques. Did the railroads to whom you sold wheels cooled with charcoal as you have described want any more of them?

Ans. In answering this question, I would state that I do not think that the railroads knew how they were made. I have talked with them about it. I have some objection to the wheels being annealed in that way. They did not think that it amounted to anything.

Ques. Then did you still say that you never found any difference in the demand for wheels by reason of the use of charcoal?

Ans. No; I never found any difference on account of using charcoal. They would never pay me any more for them.

Ques. Did you ever ask any more for them?

Ans. No; I never asked any more for them.

Ques. Am I correct in understanding that you have filled such orders for wheels as you have received at stated prices, and with a one-year warranty, without any stipulation as to the mode in which they were to be made?

Ans. Yes; I have. I never had any one to tell me how I should make them.

Ques. Does Mr. Woodward cool his wheels with sand in cans above the ground, or in pits, or how otherwise?

565 Ans. He cools them in pits down in the ground, and I understood, when I was there two weeks ago, that he did the same thing; he told me he did.

Ques. Which do you believe, from your experience in manufacturing car wheels, is the best—throwing the wheels out of the mould and allowing them to cool in the open air like ordinary castings, or using sand, as you have described, to slow cooling?

Ans. I think the best way is to put them in pits or cover them with sand.

Ques. By putting them in pits, you mean sealing them up, as you have described your own present process?

Ans. Yes; putting them in pits, sealing them up, or letting the cold air pass through the hub; I don't know which way would make them the best.

Reëxamination by defendant's counsel:

Ques. State, as nearly as you can, the aggregate number of wheels made by you, to which charcoal was applied.

Ans. I might have experimented on one, two, or five hundred; I do not want to state any number.

Ques. State just how you applied the charcoal.

Ans. The pit is a place made in the ground, lined with brick; the diameter is 36 inches; in the bottom of this pit, when I tried it, I put in probably half a peck of charcoal; the bottom was an iron air plate over an air chamber; the plate was round, with a hole in the centre; I would lay the wheel in there, and then put some charcoal on, and then put in another, and so clear up to the top. I would put in just enough charcoal to burn a little, and warm the plate a little—sometimes it would burn, and sometimes it would not; when we came to the top of the pit, we would cover the top with an iron plate; there is a hole in the centre of that plate to let the air pass through the hub and pass out.

566 When you first put the wheels in, the dratt would come out of the top of this plate through the hub; after it had got a little cool it would very often go the other way.

Ques. Have you at any time made any wheels by passing a current of air through their hubs without the use of charcoal?

(Objected to by plaintiff's counsel as new matter not touched on in cross-examination.)

Ans. Yes.

Ques. When and where?

Ans. At St. Louis.

Ques. How many?

Ans. I could not tell. I have used it more or less ever since I started at St. Louis; I did not know anything about the process when I first started.

Ques. What is the result of this process as to producing a good and durable wheel, or otherwise?

(Objected to by plaintiff's counsel for substance.)

Ans. I think if it is properly used, it is an advantage to have the cold air pass through the hub of the wheel.

Ques. How are the wheels placed by you when using this process?

Ans. They are placed in a pit, over an air chamber; then this chamber runs through a chimney; then the wheels, while red-hot, are dropped in this pit, right over this air chamber. Each wheel is put exactly over the other, till all the wheels are put in the pit that are going to be put in that day; then there is a cover put on, with a hole in the centre of it. There is a pipe that runs down to strike the hub of the wheel, and that lets the cold air pass through. The pit, with the exception of this, is all stopped up air-tight; the air passes through the hubs.

567 Ques. Have you sold wheels cooled in the manner above described?

(Plaintiff's counsel continues his objection.)

Ans. I have sold them.

Ques. State, if you know, how they operated as to wear and durability.

Ans. The best of any way that I ever tried.

Ques. By what name is such process known?

Ans. As Murphy's patent, if I recollect right.

Recross:

(Objections not waived.)

Ques. Do you know the date of the Murphy patent?

Ans. I do not.

Ques. Did you ever see the patent, or a copy of it?

Ans. No, I did not.

Ques. Did you commence with that process in 1857?

Ans. If I recollect right, I did not.

Ques. Did you use it in 1858?

Ans. I think I commenced soon after 1858. I might have done so then, or later. I cannot recollect.

Ques. Did you use it in 1859?

Ans. Yes; I used it in 1859.

Ques. In 1860?

Ans. Yes; in 1860.

Ques. In 1861?

Ans. Yes; I have used it, more or less, up to the present time.

Ques. Then you have used the sand process and Murphy process at the same time?

Ans. Yes; to try the experiment.

568 Ques. That is, you use them together for an experiment?

Ans. Yes.

Ques. Did you use them at the same time—some pits with one and some with the other process?

Ans. No; I did not.

Ques. Please explain to me in what years you used the sand process, and when you first used the Murphy process and discontinued the sand process?

Ans. I did not fully understand the previous question. I kept right on with the sand process until about 1860 or 1862; since then I have discontinued the sand process, and have used the Murphy process, more or less.

Ques. You think the Murphy process better than the sand process?

Ans. I think that the Murphy process does just as well without sand as with it, by pitting the wheels. There is no particular need of using the Murphy process; but I think it is an advantage after all.

Ques. What is the effect of the Murphy process upon a wheel?

Ans. It is to have the hub cool as fast as the plates of the wheel do.

Ques. Why is that desirable?

Ans. So as to have the wheel cool equally.

Ques. Do you own a right to use the Murphy process, or have you used it without any right?

Ans. Mr. Mowry told me that he had the shop-right for St. Louis, and that I had better commence using it. He advised me to use it.

Ques. Have you paid anything for it?

Ans. I never paid anything for it.

DAVID P. GREEN.

569 The defendant here offered in evidence and filed the same as exhibits, the—

1. Certified copy of reissued letters-patent granted Anson Atwood, dated 22d September, 1857, number 497, for cast-iron railroad wheels.

2. Certified copy of letters-patent granted John Murphy, dated August 7, 1849, number 6633, for improved method of regulating the contraction of car wheels.

3. Certified copy of letters-patent granted Anson Atwood, dated 15th May, 1847, number 5112, for cast-iron railroad wheels.

4. Certified copy of reissued letters-patent granted Anson Atwood, dated 9th June, 1857, number 468, and the certificate of extension for railroad-car wheels.

5. Certified copy of letters-patent to Nathan Washburn, dated 18th October, 1850, number 7710, for Washburn's improved car wheels.

6. And the certified copy of reissued letters-patent granted Anson Atwood, dated 22d September, 1857, number 498, for cast-iron railroad wheels.

GEORGE R. SAGE,
Special Master.

570 *Wheel account referred to in Samuel First's deposition.—Number of wheels, size, and price sold for* 1851, 1852, 1853, 1854, 1855, 1856, 1857, 1858, 1859, 1860.

	33-in.	30-in.	28-in.	26-in.	ST. CAR. 36-in.	ST. CAR. 33-in.	Grav'l	26-in.	Price.		Totals.
1851. December.	65	.....	.....	.....	.....	.....	.....	.....	$15 00	$975 00	$975 00
1852	1787	.....	.....	.....	.....	.....	.....	.....	15 00 & 17 00	27,531 00	
"	.....	704	.....	.....	.....	.....	.....	.....	14 00 & 16 00	10,160 00	
"	.....	.....	11	.....	.....	.....	.....	.....	14 00 & 16 00	172 00	37,763 00
1853	1856	.....	.....	.....	.....	.....	.....	.....	17 50 & 18 00	34,110 00	
"	.....	579	.....	.....	.....	.....	.....	.....	16 00 & 17 00	9,882 00	
"	.....	.....	93	.....	.....	.....	.....	.....	16 00 & 17 00	1,512 00	
"	.....	.....	.....	.....	.....	.....	.....	6	6 60	42 60	45,546 00
1854	1404	.....	.....	.....	.....	.....	.....	.....	18 50	25,277 00	
"	.....	249	.....	.....	.....	.....	.....	.....	17 00	4,233 00	
"	.....	.....	16	.....	.....	.....	.....	.....	14 00	224 00	
"	.....	.....	.....	.....	.....	.....	.....	12	6 60	79 20	29,803 00
1855	1707	.....	.....	.....	.....	.....	.....	.....	17 00	29,019 00	
"	.....	371	.....	.....	.....	.....	.....	.....	16 00 / 16 50 / 17 00	5,997 00	
"	.....	.....	9	.....	.....	.....	.....	.....	16 00 / 17 00	145 00	
"	.....	.....	.....	.....	.....	.....	.....	25	6 60	135 00	35,296 00
1856	3204	.....	.....	.....	.....	.....	.....	.....	16 50 / 17 00	53,731 00	
"	.....	619	.....	.....	.....	.....	.....	.....	15 00 / 15 60 / 16 00 / 17 00	8,974 00	
"	.....	.....	26	.....	.....	.....	.....	.....	15 50 / 16 00	407 00	
"	.....	.....	.....	.....	24	.....	.....	.....	11 00	264 00	63,376 00
1857	2030	.....	.....	.....	.....	.....	.....	.....	15 00 / 15 50 / 16 00 / 16 50	33,012 50	
"	.....	320	.....	.....	.....	.....	.....	.....	14 00 / 14 50 / 15 50 / 16 00	4,899 00	
"	.....	.....	52	.....	.....	.....	.....	.....	15 00 / 15 50	800 00	
"	.....	.....	.....	21	.....	.....	.....	.....	15 00 / 15 50	322 00	
"	.....	.....	.....	.....	48	.....	.....	.....	13 00	624 00	
"	.....	.....	.....	.....	.....	.....	.....	32	10 00	320 00	39,977 50
1858	1133	.....	.....	.....	.....	.....	.....	.....	14 00 / 14 50 / 15 00 / 15 50 / 16 00	16,408 50	
"	.....	328	.....	.....	.....	.....	.....	.....	15 00 / 14 50 / 14 00 / 13 00	4,592 00	
"	.....	.....	20	.....	.....	.....	.....	.....	14 00	280 00	21,280 50
1859	1135	.....	.....	.....	.....	.....	.....	.....	14 50 / 15 00	16,604 00	
"	.....	265	.....	.....	.....	.....	.....	.....	15 00 / 14 00 / 13 50	3,697 00	
"	.....	.....	30	.....	.....	.....	.....	.....	14 00	420 00	
"	.....	.....	.....	24	.....	.....	.....	.....	14 00 / 13 50	352 00	21,073 00
571 1860	1105	.....	.....	.....	.....	.....	.....	.....	15 00 / 14 25 / 14 00 / 13 50 / 14 00	15,499 00	
"	.....	205	.....	.....	.....	.....	.....	.....	13 65 / 13 50 / 13 00 / 14 00	4,079 50	
"	.....	.....	54	.....	.....	.....	.....	.....	13 00	272 00	

Wheel account—Continued.

	33-in	30-in.	28-in.	26-in.	ST. CAR. 36-in.	ST. CAR. 33-in.	Grav'l	26-in.	Price.		Totals.
1860.	.....	.....	.....	20	.....	.....	.....	.....	14 00 13 00	272 00	
"	.....	.....	.....	.....	.....	28	.....	.....	8 00	224 00	
"	.....	.....	.....	.....	.....	.....	35	.....	11 00	385 00	
											21,181 50

	33-in.	30-in.	28-in.	26-in.	24-in.		Price.		Totals.
1861.									
January...	8	.....	.....	.....	26	273 33-inch wheels, at...	14 00	$3,822 00	
February..	34	22	.....	.....	.....	48 30-inch truck, at....	13 00	624 00	
March.....	135	19	.....	.....	14	48 30-inch st. car, at...	9 00	432 00	
April.....	96	10	.....	.....	8				$4,878 00
1867.							21 00 20 50		
Ap'l-Jan ..	1023	.....	.....	.....	.....	....	19 50 18 00	20,054 00	
9 mos.									
"	.....	70	.....	.....	.....	....	21 00 19 50 17 50	1,293 00	
"	.....	.....	45	.....	.....	....	19 00 17 50 17 00	782 00	
"	.....	.....	.....	433	.....	....	15 00 16 00	6,503 00	
"	.....	.....	.....	.....	44	....	14 50	608 80	

	Street-car wheels. 33-in.	Street-car wheels. 30-in.	Coal-car wheels. 18-in.	Coal-car wheels. 26-in.	Price.		Totals.
"	8	.....	.....	.....	10 00	80 00	
"	.....	16	.....	.....	10 00	160 00	
"	.....	.....	60	.....	5 40	324 00	
							29,804 00
1868.					18 00		
Jan. -Oct..	1359	.....	.....	.....	18 50 19 00	25,399 00	
10 mos.					19 50		
"	.....	302	.....	.....	18 50 17 75 17 00	5,085 00	
"	.....	.....	76	.....	17 00 16 00	1,290 00	
"	.....	.....	.....	26	16 00 14 50 14 00	2,494 00	
"	.....	.....	.....	.....	12	11 00 10 00	132 00
"	.....	.....	.....	.....	.....	64	10 00 9 00 8 50	572 00
"	.....	.....	.....	.....	.....	.....	.....	4	11 00	400 00	
											35,016 00
Total ...	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	$386,139 00

572 *Statement of pig iron purchased by George W. Sizer & Co.—since A. D. 1855, A. L. Mowry—for the manufacture of car wheels.*

	Bought of—	Tons.	Lbs.	Price.	Totals.	
1851.						
December 2..	Green, Baum & Co.....	17	1,076	Iron, at.....$26 00	$454 33	
1852.						$454 33
January 10...	Bently, Peters & Co....	25	.....	Cold-blast iron, at.. 25 00	625 00	
February 11..	Dempsey, Rogers & Ellison.	30	.....	Etna iron, at..... 26 00	780 00	
" 11..	" " "	5	.....	Vesuvius, at 26 00	130 00	
" 18..	Hollister, Ross & Co.....	40½	.....	Iron, at 26 00	1,053 00	
" 19..	Wirts & Brother.....	50	.....	Laurel iron, at..... 25 00	1,250 00	
" 19..	" "	40½	.....	" " 24 50	1,188 00	
March 5.....	Campbell, Ellison & Co..	30	150	Raccoon iron, at 26 00	781 72	
" 5.....	" " " ..	29	300	Laurel Furnace, at.. 26 00	757 44	
June 14	Bently, Peters & Co.....	5	.....	Cold-blast iron, at... 25 00	125 00	
July 1.....	L. Hollister & Co.....	50	.....	Buffalo cold blast iron, at..... 44 00	2,200 00	
" 12.....	Dempsey, Rogers & Ellison.	10	.....	Ætna white cold-blast iron, at..... 26 00	260 00	
August 6.....	Traber & Aubery.....	26	1,401	Pig iron, at..... 27 00	718 67	
1853.						9,869 08
January 6....	Traber & Aubery.....	9	1,528	Pig iron, at..... 35 00	338 58	
" 14....	W'm D. Kelly & Bro....	52	500	Cold-blast iron, at... 47 50	2,480 47	
" 14....	" " "	5	.....	White iron, at 49 00	245 00	
" 24....	L. Hollister & Co	10	.....	Cold-blast iron, at... 47 00	470 00	
February 7...	Traber & Aubery.....	50	1,074	Pig iron, at..... 48 00	2,422 73	
March 2.....	L. Hollister & Co	19	2,050	Cold-blast iron, at... 47 00	935 48	
" 21.....	" "	30	.....	Buffalo cold blast iron, at 47 00	1,410 00	
April 16.....	Wirts & Brother.....	124	1,057	Laurel pig iron, at .. 47 00	5,849 90	
May 28.....	Campbell, Ellison & Co..	32	1,291	Howard Furnace pig iron, at 43 00	1,400 42	
July 12.....	" " " ..	48	1,280	Howard..... 43 00	1,088 27	
October 30....	Lawell, Jackson & Co...	3	2,040	Pig iron..... 46 00	179 37	
Nov. 4 ..	J. W. Donohue	1	332	Pig iron, at 28 00	32 13	
573 Nov. 4..	J. Peters & Co.....	125	.....	Washington cold-blast iron, at..... 42 00	5,250 00	
" 25..	L. Hollister & Co	144	928	Buffalo cold blast-iron, at 44 00	6,354 00	
December 15.	J. Peters & Co.....	94	.....	Washington Furnace cold-blast iron, at.. 42 00	3,948 00	
" 19..	Campbell, Ellison & Co..	70	.....	Howard iron, at 43 00	3,010 00	
1854.						36,414 33
January 2....	Campbell, Peters & Co..	50	.....	Olive cold-blast iron, at..... 45 00	2,100 00	
" 14....	Campbell, Ellison & Co..	20	124	Jackson iron, at 47 00	942 57	
" 14....	" " " ..	10	.....	Pig iron, at 47 00	470 00	
" 16....	J. Peters & Co.....	94	.....	Washington iron, at. 42 00	3,948 00	
February 13..	" "	94	.....	" " . 42 00	3,948 00	
March 21.....	Sinton & Means	5	.....	Pig iron, at..... 46 00	230 00	
April 15.....	J. Peters & Co.....	93	.....	Washington iron.... 42 00	3,906 00	
September 30.	Campbell, Ellison & Co..	5	157	Madison iron, at..... 42 00	212 91	
October 14....	" " " ..	10	.....	Greenup iron, at.... 42 00	420 00	
" 9....	" " ..	2	.....	Sandy iron..... 40 00	80 00	
1855.						16,727 48
March 15.....	J. Peters & Co.....	100	.....	Washington iron, at. 28 00	2,800 00	
April 20.....	" "	72	750	" " . 28 00	2,045 25	
July 20	Traber & Aubery	47	2,142	Etna iron, at..... 33 00	1,582 16	
September 1..	Dempsey, Rogers & Ellison.	100	.....	" 32 00	3,200 00	
" 1..	" " "	100	.....	" 33 00	3,300 00	
October 5.....	Campbell, Ellison Co	20	.....	Madison Furnace iron, at..... 36 00	720 00	
November 5 ..	Jonah A. Jackson.....	47	1,904	Pig iron, at..... 37 00	1,770 00	
" 20 ..	Campbell, Ellison & Co..	97	276	Washington iron, at. 37 00	3,593 50	
" 20..	" " ..	50	.....	Madison iron, at.... 37 00	1,850 00	
574 1856.						20,840 97
Jan. 14...	" " ..	25	374	Jackson iron, at 35 00	880 77	
February.....	C. H. & D. R. R. Co		14,048	Of wheels, at.... 1¼	175 60	
"	" "		6,089	Of old drivers and tires, at..... 1¼	76 11	
March 14.....	Stanley, Bentley & Co...	8	1,264	Eagle iron, at..... 35 00	299 50	
" 17.....	Jackson & Jones	150		Cold-blast iron, at .. 36 00	5,400 00	
" 18.....	Peters & Co	50		Washington cold-blast iron, at..... 36 00	1,800 00	
May 18.....	Jackson & Jones	34	1,680	Pig iron, at 34 00	1,181 00	
" 21.....	Traber & Aubery.....	10	.....	White iron, at..... 32 00	320 00	
June 24.....	Campbell, Ellison & Co..	24	2,258	Madison iron, at.... 34 00	849 85	
" 9.....	Traber & Aubery.....	8	103	Hamden iron, at.... 32 00	257 45	
" 16.....	J. Peters & Co.....	56	299	Washington cold blast iron, at..... 34 50	1,937 17	
" 10.....	Campbell, M'Cullough & Co.	20	1,018	Pig iron, at..... 34 00	695 26	

Statement of pig iron purchased—Continued.

	Bought of—	Tons.	Lbs.	Price.		Totals.	
1856.							
" 14	" "	15	1,742	Pig iron, at	34 00	536 11	
July 3	J. Peters & Co	150		Pig iron, at	36 00	5,400 00	
August 2	Campbell, Ellison & Co	24	1,845	Madison iron, at	34 00	843 66	
September 6	" "	24	1,889	" "	33 00	319 48	
October 31	Traber & Aubery	19	1,652	Washington iron, at	35 00	690 49	
" 21	Worthington & Co	31	1,820	Pig iron, at	36 00	1,144 89	
" 21	" "	31	1,820	"	36 00	1,144 88	
February 10	Campbell, Ellison & Co	43	859	Madison iron, at	36 00	1,561 64	
" 10	" "	25		Iron Valley, at	36 00	850 00	
December 4	" "	24	1,913	Madison iron, at	33 00	819 84	
" 22	" "	74	210	" "	31 00	2,296 87	
							30,030 55
1857.							
February 21	J. Peters & Co	125	1,016	Washington iron, at	31 00	3,888 87	
April 30	Peters, Terry & Co	51	782	Madison iron, at	31 00	1,591 68	
" 13	J. Peters & Co	50	1,852	Pig iron, at	31 00	1,575 31	
March 26	Jefferson Furnace Co	19	1,757	Cold-blast pig iron, at	31 00	612 69	
June 2	J. Peters & Co	49	2,040	Pig iron, at	31 00	1,546 88	
" 2	Peters, Terry & Co	50	1,438	Madison iron, at	31 00	1,569 66	
575 June 30	J. Peters & Co	50		Washington iron, at	$31 00	$1,550 00	
" 30	" "	4		Cambria iron, at	31 50	126 00	
" 30	Peters, Terry & Co	40	977	Madison iron, at	31 50	1,253 35	
July 23	J. Peters & Co	25	150	Pig iron, at	31 00	775 05	
							$13,871 80
1858.							
March 13	Jackson & Jones	75	770	Red River cold-blast iron, at	29 00	2,184 83	
May 22	Eagle Furnace Co	50	2,154	Cold-blast iron, at	27 50	1,401 11	
August 3	" " "	102	218	" " "	27 50	2,807 64	
September 1	Campbell, Ellison & Co	2		Madison iron, at	26 00	52 00	
December 4	" " "	9	2,068	Madison white iron, at	28 00	277 53	
							6,723 12
1859.							
January 18	Traber & Aubery	17		Jefferson Furnace cold-blast iron, at	30 00	510 00	
" 18	" "	2½		Washington iron, at	30 00	75 00	
" 18	" "	5½		Heckla iron, at	30 00	165 00	
" 21	Jack Brother	50		Red River cold-blast iron, at	33 50	1,675 00	
March 11	Traber & Aubery	3	1,322	Pig iron, at	34 00	121 82	
" 11	" "	10		Iron Valley, at	34 00	340 00	
" 7	Amer'n Iron Mountain Co.	15	418	Pig iron, at	28 00	425 16	
" 11	" " "	186	400	" "	28 00	5,212 93	
April 8	Traber & Aubery	18	930	Red River iron, at	34 00	625 94	
June 4	Eagle Furnace Co	25	929	Cold-blast iron, at	29 00	736 83	
" 10	" " "	25½		" " "	29 00	739 50	
August 24	" " "	17	510	White iron, at	28 00	482 29	
October 14	" " "	49	2,000	Car-wheel pig iron, at	30 00	1,496 45	
" 14	Traber & Aubery	3	934	Eagle Furnace iron, at	28 00	95 53	
							12,701 50
576 1860.							
January 20	Traber & Aubery	24		Jefferson Furnace cold-blast iron, at	30 00	720 00	
February 21	Clark, Mitchell & Co	23	1,754	Cambria cold-blast iron, at	28 00	655 65	
April 10	Traber & Aubery	6½		Jefferson Furnace iron, at	28 00	182 00	
		1	877	Cambria iron, at	28 00	38 82	
" 6	Eagle Furnace Co	119	1,193	Pig iron, at	28 00	3,366 72	
October 17	" " "	105	1,518	Cold-blast iron, at	26 00	2,747 40	
November 5	Cambria Furnace Co	24	1,754	" " "	28 00	693 12	
" 15	Nye, Benner & Co	15	141	" " "	26 60	400 62	
" 21	Traber & Aubery	5	1,774	Heckla iron, at	30 00	173 46	
		8	836	Cambria iron, at	28 60	234 32	
December 20	Josiah A. Jackson	180		Red River cold-blast iron, at	27 00	4,860 00	
							14,062 72
1867.							
May 13	Traber & Aubery	2		Iron Mountain, at	55 00	110 00	
		2		Red River, at	65 00	130 00	
" 21	Ohio & Mississippi R. R. Co.			36 old car wheels, 17,999 lbs., at	2½	404 78	
June 19	Collins Iron Co	48	1,178	Lake Superior, at	51 00	2,479 37	
July 20	Thomas G. Smith	16		Cold-blast pig iron, at	58 00	947 43	
" 26	Addy, Hull & Co	1		Steam cold-blast furnace, at		50 00	
August 12	Block & Hilb			28 old car wheels 13,305 lbs., at	2½	299 36	
" 14	" "			80 old car wheels, 46,430 lbs., at	2½	819 67	
" 15	" "			63 pair wheels and axles, 78,148 lbs	2½	1,758 33	

Statement of pig iron purchased—Continued.

	Bought of—	Tons.	Lbs.	Price.		Totals.	
1868.							
September 30.	Spring Grove Av. R. R. Co.	.....	.....	27 old street-car wheels, 7,486 lbs., at.....	2	149 72	
October 10....	C. H. & D. R. R. Co.....	.....	.....	52 old wheels, 25,152 lbs., at.....	2½	565 31	
" 10....	City Pass'g'r Street R. R. Co.	.....	.....	10 old wheels, 2,082 lbs., at.....	2	41 64	
" 15....	Traber & Aubery.....	10	.....	Heckla iron, at.....	64 00	640 00	
" 21....	C. H. & D. R. R. Co.....	.....	.....	32 old wheels, 16,385 lbs., at.....	2½	368 66	
November 16.	Traber & Aubery.....	10	.....	Tennessee cold-blast iron, at.....	50 00	500 00	
December 12.	Perkins, Livingston & Post.	.....	.....	71 old wheels, 35,038 lbs., at.....	2½	745 51	
" 30.	A. B. Meeker & Co.....	.....	.....	222 old car wheels, 108,520 lbs., at....	2	2,170 40	
							12,220 84
577 January	Sedamsville St. R. R. Co.	.....	.....	4 old wheels, 680 lbs., at.....	$2	$13 60	
" 18....	Jefferson Furnace Co....	193	629	Jefferson cold-blast iron, at.....	61 50	6,351 55	
March 20.....	Means, Kyle & Co.....	10	.....	Central cold-blast iron, at	46 00	460 00	
April 8.....	City Pas'nger St. R. R. Co.	.....	.....	16 old wheels, 3,040 lbs., at.....	2	60 80	
April 8.....	Cincinnati Street R. R. Co.	.....	.....	20 old wheels, 3,800 lbs., at	2	76 00	
" 30.....	M't Auburn St. R. R. Co.	.....	.....	4 old wheels, 700 lbs., at.....	1¾	12 25	
May 4.....	Sedamsville St. R. R. Co.	.....	.....	6 old wheels, 1,224 lbs., at.....	1¾	21 42	
" 12.....	City Pas'nger St. R. R. Co.	.....	.....	28 old wheels, 5,559 lbs., at.....	2	111 18	
" 23.....	Cincinnati Street R. R. Co.	.....	.....	18 old wheels, 3,586 lbs., at.....	2	71 72	
" 27.....	Addy, Hull & Co.....	8	770	Cold-blast iron, at..	48 00	400 30	
" 30.....	C. H. & D. R. R. Co.....	.....	.....	100 old wheels, 49,266 lbs., at	2	985 35	
" 30.....	Means, Kyle & Co.....	10	.....	Cold-blast iron, at..	45 00	450 00	
June 4.....	Rhodes & Co.....	10	.....	Pioneer iron, at.....	47 00	470 00	
" 30.....	C. H. & D. R. R. Co.....	.....	.....	50 old wheels, 24,670 lbs., at.....	2	493 40	
July 13.....	City Pas'nger St. R. R. Co.	.....	.....	9 old wheels, 1,620 lbs., at.....	2	32 40	
" 13.....	Cincinnati Street R. R. Co.	.....	.....	4 old wheels, 790 lbs., at.....	2	14 40	
" 21.....	Traber & Aubery	10	.....	Merrimack iron, at..	45 00	450 00	
" 21.....	" "	10	.....	Red River iron, at..	55 00	550 00	
" 31.....	C. H. & D. R. R. Co.....	.....	.....	60 old wheels, 29,897 lbs., at.....	2	597 94	
August 5.....	W'm McGhee	11	143	Lincoln cold-blast iron, at.....	55 00	609 77	
" 10.....	" "	10	2,184	" " " "	55 00	602 96	
" 7.....	Rhodes & Co	10	.....	Pioneer iron, at.....	46 50	465 00	
" 10.....	City Passenger Street R. R.	.....	.....	8 old wheels, 1,592 lbs., at.....	1¾	31 84	
" 13.....	New Orleans & R. R. Co.			61 old wheels, and freight to Cincinnati, Ohio, 28,945 lbs., at.....	1¾	578 90	
" 18.....	Traber & Aubery.....	10	.....	Heckla iron, at.....	60 00	600 00	
September 5..	W'm McGhee	10	1,804	Lincoln iron, at.....	55 00	583 75	
" 5..	C. H. & D. R. R.....	.....	.....	76 old wheels, 37,099 lbs., at.....	2	741 98	
" 11..	M't Auburn Street R. R.	.....	.....	4 old wheels, 800 lbs., at.....	2	16 00	
" 21..	Cincinnati Street R. R....	.....	.....	8 old wheels, 1,585 lbs., at.....	2	31 70	
" 21..	City Passenger Street R. R.	.....	.....	8 old wheels, 1,608 lbs., at.....	2	32 16	
578							
September 19.	Addy, Hull & Co.....	10	.....	Merrimack	46 00	460 00	
" 30.	W'm McGhee	31	1,105	Lincoln iron, at.....	55 00	1,731 79	
October 6....	Rhodes & Co.....	20	.....	Pioneer iron, at.....	47 00	940 00	
" 6....	Means, Kyle & Co.....	7	.....	Pioneer iron, at.....	45 00	315 00	
" 12....	M't Auburn St. R. R. Co.	.....	.....	4 old wheels, 800 lbs., at.....	2	16 00	
" 5....	Traber & Aubery.....	10	.....	Heckla iron, at.....	60 00	600 00	

Statement of pig iron purchased—Continued.

	Bought of—	Tons.	Lbs.	Price.	Totals.
1857.					
" 20....	Red River Manufact'g Co.	10	.....	Red River iron, at.. 60 00	600 00
" 21....	Addy, Hull & Co.....	10	.....	Hanging Rock cold-blast iron, at..... 50 00	500 00
" 21....	" " "	10	.....	Buffalo cold-blast iron, at..... 45 00	450 00
" 26....	Block & Hilb.....	.....	.....	250 old wheels, 123,000 lbs., at... 2	2,460 00
" 22....	W'm McGbee	50	1,367	Lincoln iron, at..... 55 00	2,783 15
" 31....	Traber & Aubery.....	11	1,316	Etna iron, at..... 60 00	694 81
					$27,992 81

579 *Original letters-patent, dated May* 15, 1847.

Reissued letters-patent No. 468, granted to Anson Atwood June 9th, 1857.

The schedule referred to in these letters-patent, and making part of the same.

To all whom it may concern:

Be it known that I, Anson Atwood, of Troy, in the county of Rensselaer and State of New York, have invented a new and useful improvement in cast-iron wheels for railroad-cars, and that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon:

In cast-iron car wheels, made previously to my invention, the rim of the wheel has, in some instances, been connected with the hub by means of two plates starting from near the ends of the hub, and extending to the rim. Some important advantages have been thereby obtained. Nevertheless, such a wheel is liable to a great degree of vibration and tremor from the violent concussions to which it is subjected, and besides is unnecessarily heavy and cumbersome from the disadvantageous distribution of the material of which it is composed.

I have remedied these defects, and made a stronger, lighter, and better wheel, by making the two plates unite and terminate at about halfway between the hub and the rim, (thus forming a kind of hollow ring, or arch, around the hub,) and extending thence to the rim a single plate.

580 In the accompanying drawings, Fig. 3 is a perspective, and Fig. 4 a section through the axis. C represents the solid hub; *d*, the arch or hollow ring that surrounds it; *e e*, orifices in this ring, to admit the removal of the core after the casting has been made; *a*, the rim; and *b*, the single plate connecting it with the ring or arch.

The two plates starting from near the ends of the hub, and meeting about midway between it and the rim, constitute a kind of brace to resist the lateral strain upon the wheel. Their curved form, also, as represented in the drawing, is best adapted to yield to the contraction of the metal after the setting of the rim in the process of casting.

I have made the single plate *b* in the form of a succession of radial waves passing entirely around, by a series of curves, from one edge of the rim to the other, to give a continuous support to the whole width of the rim, and provide for the contraction of the plate in the direction of the circumference of the wheel. This form also admits the flowing in of the metal to the rim without disturbing that which has preceded it, and which has set against the chill.

Other forms, however, for this plate, as well as for the two plates constituting the ring, may be substituted, without destroying the essential features of the wheel.

The place of greatest strain in railroad-car wheels, as well as in those for common roads, is at or near the hub, and that part should have greater strength of structure than those nearer to the rim. Two plates, therefore, rising from the hub and extending part of the way, and a single plate for the remainder, properly apportions the material to the strength required. And my wheel really possesses as much, indeed greater power to withstand lateral shocks, than it would have if the two plates extended all the way to the rim.

The short and bracing form, moreover, of the plates effectually destroys the vibrations and tremor found in those which extend over the whole side of a wheel.

581 What I claim as my invention and desire to secure by letters-patent is, the connecting of the rim of the wheel with the hub in cast-iron car wheels, by means of two curved plates starting from near the ends of the hub, and joining at a part of the distance between it and the rim, thus forming a hollow ring or arch around the hub, and joining said ring with the rim by a single plate, or its equivalent, for the uses and purposes above set forth.

ANSON ATWOOD.

Witnesses:
JOHN STANLEY.
L. R. LASELLE.

Certificate of extension.

Whereas, upon the petition of Anson Atwood, of Troy, N. Y., for the extension of the within patent granted to him, the undersigned, in accordance with the 18th section of the act of Congress approved the 4th day of July, 1836, entitled "An act to promote the progress of the useful arts, and to repeal all acts and parts of acts heretofore made for that purpose," and the act approved the 27th day of May, 1848, entitled "An act to provide additional examiners in the Patent Office, and for other purposes," did, on this 27th day of April, 1861, decide that said patent ought to be extended:

Now, therefore, I, D. P. Holloway, Commissioner of Patents, by virtue of the power vested in me by said acts of Congress, do renew and extend the said patent, and certify that the same is hereby extended for the term of seven years from and after the expiration of the first term, viz, from the 15th day of May, 1861; which certificate being duly

582 entered of record in the Patent Office, the said patent has now the same effect in law as though the same had been originally granted for the term of twenty-one years.

In testimony whereof I have caused the seal of the Patent Office to be hereunto affixed this 27th day of April, 1861, and of the independence of the United States the eighty-fifth.

[L. S.]

D. P. HOLLOWAY,
Commissioner.

Original letters-patent, dated May 15, 1847.

Reissued letters-patent No. 497, granted Anson Atwood September 22d, 1857.

The schedule referred to in these letters-patent, and making part of the same.

To all to whom these presents shall come:

Be it known that I, Anson Atwood, of Troy, in the county of Rensselaer, and State of New York, have invented a new and useful improvement in "cast-iron wheels" for railroad carriages, and that the following is a full, clear, and exact description of the principle or character which distinguishes it from all other things before known, and the manner of making, constructing, and using the same, reference being had to the accompanying drawings making part of this specification, in which—

Figure 1 is a perspective representation of a wheel on my improved plan;

Figure 2, a section thereof through the axis;

Figures 3 and 4 represent a modification of the same invention.

583 The object of my invention is to construct a wheel to be cast in one piece, with a solid hub, that will not be liable to break in any of its parts from undue strain upon the metal, arising from the contraction of the chilled rim cooling before the hub and disc; and it consists in connecting the rim with the hub by means of a waved plate, forming a series of curves from one edge of the rim to the other, entirely around, and extending to about midway between the rim and the hub, where it connects with a hollow ring surrounding and connecting it with the hub; this gives support to the whole width of the rim or tread, and is capable of yielding both in the direction of its circumference and diameter, without strain on the metal, the contraction of the plate and hub, in cooling after the rim.

In the accompanying drawings (A) represents the rim of the wheel of the usual form, and (B) a plate which is made in a succession of waves passing entirely around by a series of curves from one edge to the other, so that after the rim has been set by the chill, and the plate begins to cool and contract, the waved surface will yield in the direction of the circumference without producing an injurious strain on the metal. The inner periphery of this plate is connected with the solid hub (C) by a concave and convex flanch, (D,) the cross-sections of which, taken in planes passing through the axis of the hub, will present segments of circles extending from the hub to the waved plate, (B,) so as to yield to the contraction in the direction of the radii. This concave and convex flanch (D) is, in fact, a continuation of the solid hub, which gradually curves to form the connection with the waved plate.

Instead of one concave and convex flanch-like projection, or concave ring, (D,) such as above described, there may be two, one for each face of the wheel, as represented in Figure 4; and if desired to afford facility for removing the core after the wheel has been cast, one or both

584 of the flanches or concave and convex rings (D) may be made with openings, (E,) as shown in Figure 3.

What I claim as my invention, and desire to secure by letters-patent, is connecting the rim of a wheel, cast in one piece with a solid hub, by means of a single waved plate, in combination with the disked flanch or flanches of the hub, forming a ring concentric with the rim of the wheel,

substantially as described, whereby the several parts can yield to the unequal contraction in all directions, without serious strain of the metal.

ANSON ATWOOD.

Witnesses:
W. LESKI.
W'M M. SMITH.

Certificate of extension.

Whereas, upon the petition of Anson Atwood, of Troy, New York, for the extension of the within patent, granted to him, the undersigned, in accordance with the eighteenth section of the act of Congress approved the 4th day of July, 1836, entitled "An act to promote the progress of the useful arts, and to repeal all acts and parts of acts heretofore made for that purpose," and the act approved the 27th day of May, 1848, entitled "An act to provide additional examiners in the Patent Office and for other purposes," did, on this 27th day of April, 1861, decide that said patent ought to be extended:

Now, therefore, I, D. P. Holloway, Commissioner of Patents, by virtue of the power vested in me by said acts of Congress, do renew and extend the said patent, and certify that the same is hereby extended for the term of seven years from and after the expiration of the first term, viz, from the 15th day of May, 1861; which certificate, being duly
585 entered of record in the Patent Office, the said patent has now the same effect in law as though the same had been originally granted for the term of twenty-one years.

In testimony whereof I have caused the seal of the Patent Office to be hereunto affixed this 27th day of April, 1861, and of the independence of the United States the eighty-fifth.

[L. S.]

D. P. HOLLOWAY,
Commissioner.

Original letters-patent, dated May 15, 1847.

Reissued letters-patent No. 498, granted to Anson Atwood September 22, 1857.

The schedule referred to in these letters-patent, and making part of the same.

To all to whom these presents may come:

Be it known that I, Anson Atwood, of Troy, in the county of Rensselaer, and State of New York, have invented a new and useful improvement in "cast-iron wheels" for railroad cars, and that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawing through letters of reference marked thereon:

In the casting of iron car wheels with a chilled rim, the metal, in flowing in against the chill, solidifies immediately on coming in contact with it, and in the variety of wheels used prior to my invention the continuous flow of the metal in rising to fill the moulds of the rim disturbs the metal which had previously flowed in and become partially set, thus injuring the compactness of the metal in the part of the wheel on which is the most wear. The object of my invention is to prevent this,
586 which is accomplished by forming the disc of a cast-iron wheel of a corrugated or waved shape, the exterior periphery of which unites with the rim of the wheel in a serpentine or zigzag line from side

to side all round, so that the metal, in flowing in, finds a channel from first to last on a level with the surface of that which preceded it, so that it is never disturbed after it once comes in contact with the chill. This corrugated disc is also essential to compensate for the unequal contraction of the metal in the direction of the circumference, arising from the rim being cooled first by coming in contact with the chill in the process of casting.

In the accompanying drawing, Figure 3 is a perspective view of my wheel, and Figure 4 a section through the axis of the same; *c* represents the solid hub; *d*, the arch or hollow ring that surrounds it; *e e* are orifices in this ring to admit the removal of the core after the casting has been made; *a* represents the rim, and *b* the single plate connecting it with the ring or arch.

The two plates starting from near the ends of the hub, and meeting about midway between it and the rim, constitute a kind of brace to resist the lateral strain upon the wheel; their curved form, also, as represented in the drawing, is best adapted to yield to the radial contraction of the wheel after the setting of the rim from the effect of the chill thereon in the process of casting.

I cast the single plate *b* in the form of a succession of waves passing entirely around, by a series of curves or angles, from one edge of the rim to the other, to give a continuous support to the whole width of the rim, and provide for the contraction of the plate in the direction of the circumference of the wheel; also to admit the flowing in of the metal to the rim on the surface of that which preceded it without disturb-
587 ing it after it has partially set against the chill, thus ensuring a more solid rim and perfect chill.

The place of greatest strain in railroad-car wheels, as well as in those for common roads, is at or near the hub, and that part should have greater strength of structure than those nearer the rim; the two plates, therefore, rising from the hub and extending part of the way, and a single plate for the remainder, properly apportions the material to the strength required.

What I claim as new, and desire to secure by letters-patent, is—

A cast-iron disc, corrugated in the manner substantially as and for the purposes described, when used in connection with the chilled rim of a cast-iron wheel.

ANSON ATWOOD.

Witness:
W. LESKI.
W'M M. SMITH.

Certificate of extension.

Whereas, upon the petition of Anson Atwood, of Troy, N. Y., for the extension of the within patent granted to him, the undersigned in accordance with the 18th section of the act of Congress approved the fourth day of July, 1836, entitled "An act to promote the progress of the useful arts, and to repeal all acts and parts of acts heretofore made for that purpose," and the act approved the 27th day of May, 1848, entitled "An act to provide additional examiners in the Patent Office, and for other purposes," did, on this 27th day of April, 1861, decide that said patent ought to be extended:

588 Now, therefore, I, D. P. Holloway, Commissioner of Patents, by virtue of the power vested in me by said acts of Congress, do renew and extend said patent, and certify that the same is hereby ex-

tended for the term of seven years from and after the expiration of the first term, viz, from the 15th day of May, 1861; which certificate being duly entered of record in the Patent Office, the said patent has now the same effect in law as though the same had been originally granted for the term of twenty-one years.

In testimony whereof I have caused the seal of the Patent Office to be hereunto affixed this 27th day of April, 1861, and of the independence of the United States the eighty-fifth.

[L. S.] D. P. HOLLOWAY,
Commissioner.

Letters-patent No. 6633, *granted John Murphy August 7th*, 1849.

The schedule referred to in these letters-patent, and making part of the same.

To all whom it may concern:

Be it known that I, John Murphy, of the district of Kensington, in the county of Philadelphia, and State of Pennsylvania, have discovered and invented a new and improved mode of cooling, and thereby regulating the contraction of chilled railroad-car and other wheels and pulleys with solid hubs; and I do hereby declare that the following is a full, clear, and accurate description of the method adopted for effecting the cooling and contraction.

589 The many attempts that have been made to cast iron wheels in one piece with solid hubs, have, in most cases, been unsuccessful, and in the few successful modes there is a degree of uncertainty and complication in the manipulation that renders the process expensive. The object to be effected is to cause all the parts of the wheel to cool and contract in due relative proportion, in which there is found great practical difficulty, owing to the difference of the thickness of the parts, especially the hub, as compared with the other parts. As the difficulty was well known, many modes were devised to remedy the defect, and plate wheels of a curved form have been resorted to, which would yield to the strain inevitable on cooling the wheel in the usual way, but this only lessened the evil effects without removing the cause. A second mode was the attempt to chill all parts of the wheel in an iron chill, but I believe this to be wholly unsuccessful. A better mode has been patented, in which the wheels are taken from the flask and chill, and placed in an oven heated to a high degree by fire made within it; and when a sufficient number of wheels were put in this oven, it was sealed and allowed to cool gradually, occupying two or three days' time to sufficiently reduce the temperature for removal, thus retarding the cooling of the thinner parts of the casting till the heavier parts are equally reduced in temperature.

Before these specific modes above stated had been devised, it was a common thing to cool thick parts of castings by pouring water upon them, and in some instances the sand has been removed from them for that purpose, but it had always been found that it produced sudden and uneven contractions, causing the parts to strain, and when used for cooling the hubs of wheels, leaving them as unsound, or nearly so, as when left to cool in the natural way. It is in ordinary practice impossible to regulate the cooling in this way with exactness, as water cannot be kept in constant contact with the parts without re-
590 ducing the temperature too much, and any mechanical device for supplying it must be attended with trouble and expense.

It is obvious, also, when the sand has been removed from the hub as above stated, that the air will have free access to the hub, but without any means of regulating its action or produing a sufficient effect, which requires a strong current.

Hence, it has been the universal custom, nearly to the present time, to cast wheels with split hubs, a practice that is still followed by some of the best founders who have not the patented processes.

My mode of handling wheels after they are cast is to remove them from the flask and chill as soon as I can, and place them in a case of brick-work, or other non-conductor or bad conductor of heat, which case is so formed as to enclose all the wheel except the hub, and is heated so as to be air-tight; this retards the cooling of the rims and arms, which is very important, while at the same time there is no chance of elevating their temperature above the point they are at when placed in the case, so as to endanger the crystalization of the rim by the chill, and the equal cooling of these parts is insured without further attention.

To reduce the temperature of the hub, from which the core has been removed, an air pipe passes under the case to the hub at the centre, through which a rapid current of air is made to pass by fan-bellows, or other mechanical device, or by the strong draught of a chimney stack, being at the same time regulated by proper valves. When the latter plan is adopted, as shown in the drawing, a pipe leads from the centre of the case over the hub into a chimney (for this purpose I usually employ the stack of the cupola) in which a small charcoal fire may be made to assist the draught; by this apparatus I can quickly reduce the heat of the hub, and cause an exact and equal contraction, corresponding properly with that of the rim, and thus turn out a perfect wheel with comparative certainty, in about twenty-four hours or less, free from strain in any part.

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The advantage of removing the wheel from the chill is that the heat is not so rapidly extracted from it in the case as the chill would do, and all the beneficial effect produced by the chill is attained when the metal crystalizes, and the combined action of retarding the cooling of the rim and hastening that of the hub in the manner above set forth relieves the parts from all strain.

The mode of operation and construction is as follows: The description of the parts of my apparatus may be simplified by reference to the annexed drawings, making a part of this specification, in which—

Figure 1 is a side view of the case;

Figure 2 is a top view of the wheel when in the case; and

Figure 3 is a top view of the cover of the case.

I will proceed to describe my invention by reference to the drawings.

A is the cover or top of the case, made of brickwork or other non-conductor of heat, bound with iron rings on the outside and in the centre over the hub, which is left exposed.

(o. o′.) are handles to this top or cover, by means of which its position may be changed.

($w'''.''.'''$) indicates the brick work of this top or cover.

(*a*. *a′*.) are holes in the top or cover, through which the temperature of the rim of the wheel may be watched.

p. *p′*. are plugs or stoppers made of clay or other non-combustible materials, with which to close the apertures *a*. *a′*.

B is the wheel in the case.

n is the eye of the wheel.

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v′ the holes on the outside of the hub, which are made in the sand, and through which the air passes.

C is the brickwork of the case.

b indicates the bricks around the tread of the wheel.

D is the pipe or flue leading from the top of the hub into the stack or chimney L, through the hole therein marked E.

F indicates the inside of the trunk or pipe under or in the case, through which passes the stream of cold air to the hub of the wheel.

x is the door or gate at the mouth of this trunk or pipe, through which the cold air enters by natural draught.

m shows a smaller door at the aperture O, in the side of this pipe or trunk, through which the cold air enters by a bellows-fan, &c.

G is a valve in the pipe or flue D, which regulates the amount of air passing through and around the hub.

H indicates a cover over an aperture in the top of the pipe or flue D, through which aperture a slight bar may be inserted with which to push out the core from the eye of the wheel, after it is placed in the case.

In this cover is inserted a glass, through which the temperature of the hub may be watched.

g shows the sand or clay filling up the joint between the inner ring of the top or cover of the case and the outside of the flue or pipe D, over the hub, and *g'* the sand or clay in the joint below the handles, between the case and its cover, thus making these joints air-tight.

What I claim as my invention and discovery, and desire to secure by letters-patent, is—

593 The mode of cooling, and thereby regulating the contraction of chilled railroad-car and other wheels and pulleys with solid hubs, by the application of a stream of cold air to the hub, in the manner above described, in combination with the non-conducting case for retarding the cooling of the rim as herein set forth.

JOHN MURPHY,
April 13th, 1849.

Witnesses:
JNO. CLAYTON.
ARMON DAVIS.

Certificate of extension of letters-patent No. 6633, granted John Murphy August 7th, 1849.

Whereas, upon the petition of Mary Murphy, administratrix of the estate of John Murphy, deceased, of Philadelphia, Pennsylvania, for the extension of the patent granted to the said John Murphy, on the 7th day of August, 1849, the undersigned, in accordance with the 18th section of the act of Congress approved the 4th day of July, 1836, entitled "An act to promote the progress of the useful arts, and to repeal all acts and parts of acts heretofore made for that purpose," and the act approved the 27th day of May, 1848, entitled "An act to provide additional examiners in the Patent Office, and for other purposes," did, on this 5th day of August, 1863, decide that said patent ought to be extended:

Now, therefore, I, Daniel P. Holloway, Commissioner of Patents, by virtue of the power vested in me by said acts of Congress, do renew and extend the said patent, and certify that the same is hereby extended for the term of seven years from and after the expiration 594 of the first term, viz, from the 7th day of August, 1863; which certificate being duly entered of record in the Patent Office, the said patent has now the same effect in law as though the same had been originally granted for the term of twenty-one years.

In testimony whereof I have caused the seal of the Patent Office to be hereunto affixed this 5th day of August, 1863, and of the independence of the United States the eighty-eighth.

[L. S.] D. P. HOLLOWAY,
Commissioner.

Letters-patent No. 7710, *granted Nathan Washburn October* 8, 1850.

The schedule referred to in these letters-patent, and making part of the same.

To all to whom these presents shall come:

Be it known that I, Nathan Washburn, of Worcester, in the county of Worcester, and State of Massachusetts, have invented certain new and useful improvements in the manufacture of cast-iron car wheels, and that the following is a full, clear, and exact description of the principle or character which distinguishes them from all other things before known, and of the usual manner of making, modifying, and using the same, reference being had to the accompanying drawing, in which Figure 1 is a side elevation of the wheel; Figure 2 is an elevation of the opposite side; Figure 3 is a section in the plane of its diameter.

My improvements consist in the manner of disposing of the
595 metal in the wheel, so as to produce great strength, and relieve the wheel from strain when cast and properly chilled, thus avoiding most of the defects to which ordinary wheels are liable when cast whole.

The rim (a) of the wheel is of the ordinary form, and is cast in a chill; the hub (b) is also similar to wheels now in use, but with less thickness of metal; from each end of the hub two arch-shaped plates (c.c′.) project radially outward all around, and join at a point half the semi-diameter of the wheel from the centre, or a little beyond it; to form this part of the wheel a core is necessary, the application and construction of which is well known to persons engaged in the manufacture of other wheels; where cores are used, the openings (*d*) being for the purpose of sustaining the core; from the front junction of the two plates there is an extension of a single plate (*e*) curved in its radial section and forming an ogee with the front plate (*e*); on the concave face of this extension (*e*) curved arms or brackets (*i*) are affixed perpendicular to the face of the plate, and gradually tapering from the rim (*a*) to the junction above named of the plates (c.c′.;) the outer face of these brackets are nearly flush with the face of the wheel, as clearly shown in the cross-section, Figure 3. I have found that a wheel of the above-described construction is capable of standing the severest tests to which car wheels are ever subjected; they are also lighter and stiffer than any other wheel with which I am acquainted.

Having thus fully described my improved cast-iron wheel, what I claim therein as my invention, and for which I desire to secure letters-patent, is the combination of the arch at the centre with the curved plate and arms, or brackets, connecting the hub and rim in the manner and for the purpose set forth.

NATHAN WASHBURN.

Witnesses:
J. J. GREENOUGH.
J. H. GODDARD.

596 U. S. circuit court, southern district of Ohio.

ASA WHITNEY *vs.* ALBERT L. MOWRY. } 534.

Deposition of witnesses produced, affirmed, and examined by me, the ninth day of December, A. D. 1868, at my office, No. 510 Market street, in the city of Wilmington, in the State of Delaware, between the hours of ten o'clock a. m. and six o'clock p. m., by virtue of the master's appointment, a copy of which is hereunto annexed, and in conformity with the notice, also hereto attached, for the examination of witnesses in the above-stated cause.

Present, Henry Baldwin, jr., counsel for plaintiff; Charles B. Collier, counsel for defendant.

GEORGE G. LOBDELL, being produced and affirmed, doth depose as follows:

Questions by Charles B. Collier, counsel for defendant:

Question 1. Where do you reside, and what is your occupation?

Answer. I reside in New Castle Hundred, New Castle County, in the State of Delaware. My occupation is that of a founder, machinist, and manufacturer of chilled railroad-car wheels.

Ques. 2. How long have you been engaged in the business of manufacturing and selling cast-iron railroad-car wheels?

597 Ans. I commenced manufacturing in 1833, and commenced selling in the year 1839, being then in business for myself. I have been engaged in the business from that time to the present, without any intermission.

Ques. 3. Do you use any method or process for annealing or prolonging the time of cooling cast-iron car wheels? If yea, will you please state what that process is, and for what length of time you have practised it?

Ans. I do. We place the wheels in a pit and cover them with hot sand, the wheels being removed from the moulds or chills as soon as they will bear handling. To the best of my recollection, we commenced covering the wheels with hot sand in December, 1847, or January, 1848, or about that time.

Ques. 4. What kinds or forms of car wheels do you make, or have you made, by such annealing or slow-cooling process, whether double or single plate, or both?

Ans. We make and have made, by this process, double and single plate, and hollow spoke wheels; also wheels with solid spokes. The spoke wheels are open between the spokes, having no plate between them.

Ques. 5. State to what extent you have made wheels which have been cooled in the manner you have described. State the aggregate number, or approximate to it as nearly as you can.

Ans. All the car wheels made by us since we adopted the process or mode of cooling referred to have been made by that process, and some years we have made as high as thirty thousand wheels; we have made near forty thousand some years.

Ques. 6. State whether the wheels so made by you have been sold; if so, where and to whom, or to what companies principally?

598 Ans. All of them have not been sold; I have broken up many thousand of them in my life-time. The wheels have been sold

to nearly all the leading railroads in the United States. Our largest customers have been the Philadelphia, Wilmington and Baltimore Railroad Company, the Pennsylvania Central Railroad Company, New York and Erie Railroad Company, Union Pacific, Union Pacific Eastern Division, and very many others.

Ques. 7. State whether or not, in the process of casting wheels in the moulds, they are ever injured or impaired; if so, the percentage of loss of wheels from such cause?

Ans. All wheels cast are not perfect; the imperfections may be occasioned by a want of care on the part of the moulder, from the iron being too soft, or from its being too hard, or not of a proper quality otherwise. The percentage of bad wheels from all these causes—wheels which we would not sell, but break up—would vary very much; at times it might be five per cent., at other times it might be ten per cent., or less than five per cent. sometimes. I have broken up many thousand wheels which other wheel-makers might have sold.

Ques. 8. In the deposition of Asa Whitney heretofore taken in this case, he was asked—

Question 2. (Page 2 printed copy.)

"Please state what you consider to be the value per wheel, of your patent of April 25, 1848, in the manufacture of cast-iron railroad-car wheels, with the particulars of the estimate you place upon it."

To which question the witness answered, in part, as follows:

First. The wheel is cheaper, having an average of ten pounds less weight than those treated in the ordinary way, &c.

On cross-examination of said Whitney, he produced a statement of the sizes and weights of wheels, a copy of which is now shown you, and annexed hereto, marked Exhibit W. Will you please exam-
599 ine the same, and state whether or not the statement of Mr. Whitney, as to the weight of his wheels, compared with wheels made by your process, is or is not correct?

Ans. The weight of the wheels given in the table referred to, which I have examined, is the same as the weight of the wheels of the same diameter and width of tread made by us, excepting three, which are heavier, and one which is lighter.

Ques 9. In the concluding portion of the answer of Mr. Whitney to the question referred to, he says: "Thirdly. The wheel is more durable, because we can make it harder, and free from all inherent strain; consequently, the wheel sells more readily, at least, by a difference of one dollar a wheel more than those made in the ordinary way." Will you please state whether or not the statement so made by Mr. Whitney, as to the effect of his process, and the commercial value of his wheel, is correct or otherwise, as compared to the effect of your process, and the commercial value of your wheels thus made?

(Objected to by plaintiff's counsel, because the witness is not instructed what Mr. Whitney means by wheels made in the ordinary way, and because it does not appear that the process of this witness is the ordinary way of making wheels, and because it asks the witness to assume one basis, and contradict a witness who speaks from another basis, of which the present witness has not been apprized.)

Ans. I do not think that the wheels made by Mr. Whitney's process are any better (by the process of making I mean cooling) than those cooled by the process used by us. We have never, knowingly, sold wheels for a less price than what we believed Messrs. A. Whitney & Sons were asking for their wheels of the same diameter and description.

600 Ques. 10. Have you, at any time during the past ten years,

received greater prices for your wheels than were received at the same time for wheels of same character, made and sold by Whitney & Sons?

(Objected to by plaintiff's counsel, as assuming that A. Whitney & Sons have made wheels of the same character as those made by the witness.

Counsel for defendant adds, by way of explanation of the preceding question, and before answer, that by the word character is meant size and weight, and width of tread.)

Ans. That is a question I cannot answer, as I do not know what Whitney & Sons have received.

Ques. 11. Who, beside your firm, if any one, supplies the Philadelphia, Wilmington and Baltimore Railroad?

(Objected to by plaintiff's counsel, as being irrelevant, and only properly to be answered by the officers of said road.)

Ans. They buy but very few wheels of any other concern. They occasionally buy four or eight wheels to try under an engine or a car, in connection with our wheels.

Ques. 12. What is the character of said railroad, compared with other roads, so far as known to you, as to amount of travel and speed of trains?

Ans. I presume there are a greater number of passengers conveyed over this road than any other road I know of, and they travel at a high rate of speed. I think I should except the Camden and Amboy Railroad as to number of passengers, but not as to the speed of trains.

Ques. 13. State the result of your observation as to the wear and durability of your wheels cooled by the process you have described, as compared with cast-iron wheels annealed or cooled by any other process known to you.

601 Ans. I believe our wheel will wear as long as any other wheel that is made.

Ques. 14. Have you, at any time during the past ten years, seen the price-list of Asa Whitney & Sons' wheels?

Ans. Yes.

Ques. 15. When, and how often?

Ans. Probably have a dozen times in ten years.

Ques. 16. How did their prices at such times correspond with prices then received by you for wheels of corresponding sizes?

Ans. They were generally the same.

Ques. 17. State whether or not, prior to 1847, you slow-cooled cast-iron chilled car wheels in any manner. If so, how and when?

(Objected to by plaintiff's counsel: 1st, as not pertinent, relevant, or competent, under the order of the court, entered November 23d, 1868; 2d, because if it is intended to impeach the witness or contradict him, it is not competent for the defendant to do.)

Ans. I have covered up with sand the rim and spokes of railroad wheels, thus excluding that part of the wheel from the air, and exposed the hub, and sometimes cooled it by pouring water in the hole made in the hub of the wheel, thus causing the different parts of the wheel to cool more nearly at the same time, but found this an uncertain process of cooling. This was done prior to 1839, in the city of Wilmington, Delaware.

602 Questions propounded by plaintiff's counsel:

Question 1. Are you the same George G. Lobdell who gave a deposition in this cause on or about the third day of August, 1866?

Answer. I was examined in this office by General Burnett some time in the summer of 1866.

Ques. 2. Was your deposition then given true at that time, and is it true now?

(A copy of deposition was here shown witness for his examination.)

Ans. I have read that deposition, and desire to qualify my answer to question No. 17 of this deposition, by saying that we never practised the process of slow-cooling prior to 1839 to any extent; and in my answer to the twelfth question, taken heretofore, I meant to imply that I did not use continuously any other process than the sand process, which I have been using, and still continue to use.

Ques. 3. Then prior to your use of your sand process, which you now use, you did not pit your wheels?

Ans. No, we did not.

Ques. 4. You did not cover them with sand, as you now do?

Ans. We did not.

Ques. 5. You did not make them with solid hubs, as you now do?

Ans. The wheel known as the Bush & Lobdell wheel, the plates of which were convex on the outside prior to this date, January, 1848, were made with a divided hub, as described in the letters-patent, March 17th, 1838, granted to Bush & Lobdell. Bush & Lobdell made
603 wheels under license, or by an arrangement with George W. Eddy, one plate of which was convex, and the other undulating or waved, with a solid hub. I think they made these wheels as early as the spring of 1848. The date I can fix exactly by reference to my papers, which I will do. It was not necessary, or considered necessary, to pit the Eddy wheel, on account of the form of the plate. Having referred to my papers, I find the true date was about December, 1847.

Ques. 6. By the sand process, as used by you, do you anneal your wheels, as well as slow-cool them?

Ans. I would like to have Webster's Dictionary, to see what you mean by anneal. According to the definition given by Webster, edition of 1854, we do not anneal; we simply prolong the time of cooling, and cause the different parts of the wheel to cool at the same time; and yet it is partially true, inasmuch as the heat in the hub and tread of the wheel (the hub more particularly) which are the hottest, when removed from the chills may be communicated, to a limited extent, to the plate, thus making the plate somewhat hotter than when placed in the pit.

Ques. 7. Aside from Webster, and in the technology of your business as car wheel maker, are your wheels annealed or unannealed wheels?

Ans. The term annealing, as I have been accustomed to apply it to metals of all descriptions, means to soften, and we do not consider our wheels annealed, although some use that term in connection with the process used by us in cooling wheels. Railroad-men sometimes ask whether we anneal our wheels by covering them with sand or by placing them in a furnace.

Ques. 8. Do you sell your wheels as annealed or unannealed wheels?

Ans. We do not sell them as either. We sell them as wheels
604 free from strain. Unless the question is asked, we make no reference to the process of cooling.

Ques. 9. Do you know of any roads which use annealed wheels?

Ans. I know of roads which use Mr. Whitney's wheels, which he claims to be annealed, and I have heard of wheels which were claimed to be annealed, which were made in Jersey City, New Jersey, used on roads.

Ques. 10. Have you any competition with annealed wheels, as such?

Ans. Every wheel-maker comes in competition with us.

Ques. 11. Is the competition between annealed and unannealed wheels, other things being equal?

Ans. I do not think it is. By this I mean it would make no difference in our selling wheels at this time whether they were called annealed wheels or not.

Ques. 12. Would it at any time, since you commenced using the sand process?

Ans. Some time ago a concern in Jersey City advertised and used a good deal of exertion in introducing what they termed an annealed wheel; claiming that by their process the plate of the wheel was made softer, consequently tougher, and that they could make a lighter wheel than without the use of their process. Some of those who had heretofore been our customers were induced to use some of these wheels, which did not prove what they were recommended to be. This is the only instance that I know of our having lost the sale of wheels by wheels called annealed wheels coming in competition with ours.

Ques. 13. Is the Whitney wheel known in the trade as an annealed wheel?

Ans. That is a pretty difficult question to answer, as the
605 term annealed is improperly applied to both processes—the sand process and the Whitney process—from the fact that some makers and buyers call the sand process annealing. I believe Mr. Whitney sells his wheels as annealed wheels, and always has done so.

Ques. 14. If a railroad-man asks you whether you anneal by the sand process or by the furnace, what do you answer?

Ans. I should say we cover them up in hot sand; and if he asked me if that annealed them, I would say it prolonged the time of cooling so that all parts of the wheel would cool at the same time and be free from strain, without softening the chill or affecting it in any way injuriously.

Ques. 15. If he asks you categorically, "Are your wheels annealed or unannealed wheels?" what is your answer to that?

(Question objected to by defendant's counsel as having been already fully answered, and for the further reason that the witness has said that the term annealing is applied to both the sand or slow-cooling and the furnace processes.)

Ans. It would depend upon the man who asked me. If he was an educated man, and understood the use of the term annealed, I should tell him they were not annealed, but cooled by covering up in sand; if he was a master-mechanic with limited education, I should tell him they were annealed in hot sand. I would not mean to convey to any one the idea that they were annealed by being heated to any great extent hotter than they were when taken from the chill or mould. I believe the temperature of the plate is elevated to a limited extent.

Ques. 16. What other process, whether of annealing in connection with the prolonging of the cooling, or of prolonging the cooling without annealing, do you know of being practised in the manufacture of cast-iron car wheels during the past ten years?

606 Ans. I know of no other process or processes, excepting that known as the sand process—that patented by Mr. Whitney; that by Mr. John Murphy, known as the cold-air process; the process patented by Mr. Mowry, and the process referred to as having been used at Jersey City. Some forms of wheels do not require any of the above-described processes, on account of the form of the plate.

Ques. 17. State, if you please, as nearly as you can, the cost of fitting the wheels, covering them with sand, removing them when cooled, taking out the sand so as to fill the pit again—in short, the cost per wheel of the use of sand in your process?

Ans. Owing to the manner in which our pits are constructed, it is very trifling, not exceeding two dollars a day for one hundred and fifty wheels.

Ques. 18. What would you estimate the cost of said labor, if you used sand in pits, such as are used in the furnace process, each pit holding ten wheels thirty-three inches in diameter?

Ans. A pit of this description would be forty inches in diameter, and not less than nine feet, consequently the sand would have to be hoisted out. I should estimate the cost at ten cents for each wheel, and think it would be a difficult matter to get men to work on them at all.

Ques. 19. Do you understand Mr. Whitney's patented process?

Ans. I believe I do; I have read his claim.

Ques. 20. Do you believe that you run your metal at as high a heat as he does?

Ans. I believe that our wheels are poured hotter than those made by Messrs. Whitney & Sons.

Ques. 21. Do you believe that they are pitted hotter than Whitney & Sons' wheels?

Ans. I don't think there is any difference in that respect, as they
607 are both placed in the pits as soon as they will bear handling. I do not know, of my own knowledge, what degree of heat there is in the wheels of Messrs. Whitney & Sons when they are placed in their pits.

Ques. 22. Do you believe that your wheels are as hard and as tough as the Whitney wheels?

Ans. I believe they are as hard on the tread and as tough as the Whitney wheel.

Ques. 23. Out of a thousand wheels cooled by your process, how many crack or come out defective on account of strains?

Ans. Not any, if they are properly covered with hot sand, and have not been allowed to remain in the moulds until they have become too cold.

Ques. 24. In practice, what is the average of loss from insufficient attention or carelessness of workmen in these respects?

Ans. I cannot tell, but I do not think we lose one in five hundred from that cause.

Ques. 25. What mileage do you guarantee your wheels to run?

Ans. We generally warrant them to run a year, or as many miles as any other wheel made; we prefer to guarantee them to run a year rather than any number of miles.

Ques. 26. Would you consider your wheel safe and reliable if you made it thirty-five or forty pounds lighter than you do for given service?

Ans. I would not recommend a railroad officer to use a very light wheel; I have known thirty-three-inch wheels of our make, weighing four hundred and eighty pounds, to run for years under passenger-cars; we advise railroad-men to use a five-hundred-and-thirty-pound wheel for such service.

Ques. 27. When you made the divided hub Bush & Lobdell wheel, or the split-hub spoke wheel, what did it cost in material and labor to finish them up when cool?

608 Ans. It cost nothing for the Bush & Lobdell wheel, more than any other wheel. The spoke wheel cost the keying and banding,

which might be about from two to three dollars per wheel. We sometimes filled the space in the hub of the Bush & Lobdell wheel, when we knew the wheels would be drawn on the axles by inexperienced parties, at about a cost of ten cents a wheel.

Ques. 28. Are you not of longer experience, and have you not greater skill in the manufacture of cast-iron railroad-car wheels than any other person in the United States?

Ans. I believe I am the oldest manufacturer of chilled cast-iron car wheels in the world, and that I have had a greater personal experience in mixing and managing of cast-iron used in chilled cast-iron car wheels than any other person known to me. As to the skill, I prefer that others should answer.

Ques. 29. Except Whitney & Sons, do you know of any manufacturer who has at any time made anything like such numbers of wheels per annum as you have made?

Ans. I do not.

(At request of counsel for complainant, witness produces, to be annexed to his deposition, a copy of his price-list, marked Exhibit G. G. L.)

Counsel for defendant offers the following questions:

Question 1. In view of your experience, of which you have testified, to which process of cooling car wheels, Whitney's or the sand process practised by you, do you give the preference, and which, in your opinion, is most profitable to the manufacturer and produces the best wheel?

(Objected to by plaintiff's counsel, because the witness has had no experience of the Whitney process.)

609 Answer. I prefer the sand process; can't speak as to which is most profitable, and believe that a wheel properly cooled in hot sand will be the best.

Ques. 2. If your wheels were placed in previously-heated ovens after their removal from the moulds, and there heated to a point, say a little below which fusion commences, and then allowed gradually to cool, as described in the patent of Mr. Whitney, would they cost more or less than they cost as treated by you?

(Objected to by counsel for plaintiff.)

Ans. I have never used Mr. Whitney's process, and cannot say; my opinion is, that it would cost more by Mr. Whitney's process than by the sand process as used by us.

Ques. 3. What, if anything, has the quality of the iron, the melting of the iron, the mixing of the iron, the pouring and the moulding of the wheel, the form of the wheel, or either of these things, to do with the utility and the durability of the wheel?

Ans. All are important considerations in the manufacture of a perfect railroad-car wheel.

Ques. 4. State whether or not wheels slow-cooled, as made by you prior to 1839, testified to in your examination-in-chief, were sold and used; if so, how many, and how did they wear?

Ans. Yes; some of them were sold; they were the first wheels made of the Bush & Lobdell patent, dated March, 1838; they were used on the Philadelphia, Wilmington and Baltimore Railroad; the number was few; I cannot say how many; they wore well; all so sold were tested before delivery.

Questions by plaintiff's counsel:

Question 1. What has the chill to do with the utility and durability of a car wheel?

610 Answer. On the character of the chill depends altogether the durability of the wheel, so far as its wearing is concerned, but not as to its strength.

Ques. 2. Does not the necessity of having a chill wearing surface to run on the rail, and the provision made for such surface by casting the wheel on a chill, create the necessity of providing some special means for counteracting the strains resulting from the contraction of the casting thus formed in cooling?

Ans. It does, unless the form of the wheel is such as to yield or accommodate itself to the unequal cooling of the different parts of the wheel, as was in the case of the Bush & Lobdell, Eddy, and other plate wheels.

Questions by defendant's counsel:

Question 1. What, in your opinion, is the effect upon the chill of a wheel if it is reheated to a degree beyond that it has when taken from the mould, so soon as the wheel has cooled enough to be capable of being handled?

(Objected to as a question upon which the court has passed.)

Answer. It would depend altogether upon the degree it was heated. If it was heated but slightly, it would not affect the chill, but it might be heated to a sufficient degree to soften the chill.

Ques. 2. How, if heated to a point, say a little below that at which fusion commences?

(Objected to as irrelevant, in view of the decision of the court in this case.)

Ans. I think that it would soften the chill.

GEORGE G. LOBDELL.

611 STATE OF DELAWARE,
New Castle County, ss:

I, William B. Wiggins, notary public for the county and State aforesaid, and special commissioner named in the commission hereunto annexed, do hereby certify that the foregoing deposition was duly taken, affirmed to, and subscribed before me at the time and place mentioned in the caption thereof.

Given under my hand and seal of office this ninth day of December, in the year of our Lord one thousand eight hundred and sixty-eight.

[L. S.] W'M B. WIGGINS,
Notary Public and Special Commissioner.

STATE OF DELAWARE, *New Castle County, ss:*

I hereby certify that I have carefully compared the foregoing copy of the deposition of George G. Lobdell, and the paper writings thereto attached, together with my certificate appended with the originals, and find that the foregoing twenty-four pages, and the papers thereto attached, are a true and correct copy of the deposition of the said George G. Lobdell, the witness therein named, and of the exhibits thereunto attached, as taken, attached, and certified to by me, on the day that the same bears date.

In testimony whereof I have hereunto set my hand and affixed my seal of office this tenth day of December, in the year of our Lord one thousand eight hundred and sixty-eight.

[L. S.] W'M B. WIGGINS,
Notary Public and Special Commissioner.

612 EXHIBIT G. G. L.—*The Lobdell Car Wheel, Fire and Machine Company, Wilmington, Delaware.—Lobdell's improved single-plate wheel.*

	Width of tread.	Diameters, weights, and prices of wheels.													
		24-inch.		26-inch.		28-inch.		30-inch.		31-inch.		33-inch.		36-inch.	
Chilled wheels, viz:		*Lbs.*	*Dolls.*	*Lbs.*	*Dolls.*	*Lbs.*	*Dolls.*	*Lbs.*	*Dolls.*	*Lbs.*	*Dolls.*	*Lbs.*	*Dolls.*	*Lbs.*	*Dolls.*
For gravel, coal, and freight cars	4-inch	325	11 48	350	12 52	400	14 10	440	15 66	.....	.....	500	17 75	585	20 87
For light tenders and passenger cars	4½-inch	.....	.....	380	13 57	425	15 13	480	16 97	.....	.....	530	18 79		
For heavy-class engines and tenders	4-inch	370	13 05	375	13 31	450	15 92	480 470	16 97 16 70	.....	.....	530	18 79		
For passenger and express cars	4½-inch	.....	.....	.....	.....	.....	.....	510	18 00	530	18 79	575	20 36		
For coal cars	4½-inch	.....	.....	.....	.....	.....	.....	460	16 44						

613 **Wheels with extra width of tread, add for increased weight, per lb.:**

Solid chilled tire, 5¼c. per lb.
Hollow chilled tire, 5c. per lb.
For mining-cars and other light service, wheels 15 in., 18 in., and 24 in., 4c per lb.
Heavy double-plate wheels: 24 in., $14; 26 in., $16; 28 in., $17 50; 30 in., $19; 33 in., $21 50; 36 in., $24 75, each.
Hollow-spoke wheels: 26 in., $16; 28 in., $17 50; 30 in., $19; 33 in., $21 50, each.
Boring wheels accurately to standard gauges, 25c. per wheel.
Fitting wheels on axles, including boring wheels, wheels and fitting guaranteed against defects, $1 per wheel.
Hammered and rolled axles furnished at manufacturers' prices.
Delivered at New York.
Terms: Cash (unless otherwise agreed) within 30 days of date of bill, in New York or Philadelphia funds.
Change of price: Above prices are subject to alteration, without notice.
Issued May, 1868.
To—

EXHIBIT W.

Kind of wheel.		Sizes and weight of wheels.						
		24.	26.	27.	28.	30.	33.	36.
For engine trucks and tenders	4 tread	335	350	.....	400	440	500	585
For passenger, freight, and other cars of ordinary trains	4½ "	.....	380	.....	425	480	560	.....
For engine trucks and tenders	4 "	.....	375	.....	430	480	550	.....
For cars of fast express trains and other heavy service	4½ "	.....	.....	.....	.....	.....	585	.....
For coal cars (used on Lehigh Valley and Lehigh Coal and Nav. Co.'s R. R.)	4½ "	.....	.....	.....	.....	460	.....	.....
For street cars	1½ "	145	.....	180	.....	210	275	305

614 U. S. circuit court, southern district of Ohio.

ASA WHITNEY
vs. } 534.
A. L. MOWRY.

The complainant will take notice that the defendant will take testimony, to be used before the special master in the above cause, before William B. Wiggins, esq., at his office, No. 510 Market street, in the city of Wilmington, in the State of Delaware, on Wednesday next, December 9th, between the hours of ten o'clock a. m. and 6 o'clock p. m.

CHARLES B. COLLIER,
Attorney for Defendant.

Due service accepted this 5th day of December, 1868.

HENRY BALDWIN, JR.,
Complainant's Solicitor.

Circuit court United States, southern district of Ohio.

ASA WHITNEY
vs. } In equity.—No 534.
A. L. MOWRY.

Upon the complainant's motion the master appoints William B. Dayton special commissioner to take testimony at the city of Philadelphia,
615 State of Pennsylvania, to be used before the special master in the above-entitled cause; and upon the motion of the defendant, by his counsel, the master appoints Edward H. Nicholl, of the city of New York, special commissioner to take testimony in said cause at said city of New York, and William B. Wiggins, to be special commissioner to take testimony in said cause at Wilmington, in the State of Delaware.

Done by the order of the special master, this second day of December, A. D. 1868.

(Signed) GEORGE R. SAGE,
Special Master.

DECEMBER 9TH, 1868.

True copy of appointment.

[L. S.] W'M B. WIGGINS,
Notary Public and Special Commissioner.

U. S. circuit court, southern district of Ohio.

ASA WHITNEY
vs.
ALBERT L. MOWRY.

Charles B. Collier appeared for defendant; Henry Baldwin, jr., appeared for plaintiff.

HORATIO G. BROOKS, a witness produced on the part of the defendant, being by me first duly sworn to tell the truth, the whole truth, and nothing but the truth, deposes and says:

Horatio G. Brooks sworn on the part of the defendant:

Question by Charles B. Collier, counsel for the defendant. Where do you reside and what is your occupation?

616 Answer. I reside in New York City. I am superintendent of the motive power of the Erie Railway.

Ques. For how long have you been so occupied?

Ans. Since March, 1865. I have been with the Erie Railway since October, 1850, with the exception of the time between November 1st, 1856, and April 1st, 1860, during which time I had charge of machinery department on Ohio and Mississippi Railroad.

Ques. State whether or not, during any portion of the said period, you have seen cast-iron car wheels made. If so, state what process, if any, was applied to said wheels for the purpose of annealing or slow-cooling them. State, also, when and where you have seen them made.

Ans. I have seen cast-iron car wheels made. I have never to my knowledge seen Mr. Whitney's process used. Those I have seen have used the process of cooling them in sand—putting a number of them in a pit—covering them up with sand. In fact I do not know of ever having seen any other process of cooling. Have seen this at Washburn's and Hunt's foundries, at Scofield's, and my impression is that I have seen it at Mr. Mowry's foundry during the time I was on the Ohio and Mississippi Railroad, but I would not swear to it.

Ques. Have you had any experience in using car wheels manufactured by Whitney & Sons, of Philadelphia?

Ans. I have had no experience with the Whitney wheel myself, personally. The reputation of the wheel generally is not as good as those of some other makers, and that is the reason I have never used them. I don't attribute the imperfect quality of his wheels to any annealing process he may or may not have, but owing to the inferior quality of the iron he uses.

Ques. Have you seen Whitney's wheels in use; if so, when and where?

617 Ans. I have; they have been in use on the cars of the Atlantic and Great Western Railroad; the cars of which have run over the Erie Road.

Ques. By what process, if any, of slow-cooling are the wheels now in use on the Erie Railroad made?

(Objected to—witness having already said that he never saw any other process of cooling except the sand process.)

Ans. A portion of them by the process I have mentioned as having seen, and others being placed in a pit without sand, and the mouth of the pit closed air-tight, the wheels remaining until cooled. It is my impression that this last process is the one which is generally used now.

(Answer objected to, as to the latter part.)

Ques. State the result of your experience and observation, as to the wear and durability of car wheels cooled by the sand process, which you have described as compared with the Whitney wheel, or any other wheel with which you are acquainted.

(Objected to.)

Ans. The use of the process of annealing, I believe simply to be the gradual cooling, so that the unequal distribution of weight of metal in different parts of the wheel, may by a retained uniform temperature, be uniform throughout such unequal distribution of weight. The idea I wish to convey is, that any unequal distribution of metal must be cooled gradually and uniformly by some process, in order to obtain the requisite strength in the material after it has cooled, and any process that will allow the material to be thus cooled gradually, accomplishes the result desired. I would not give anything for one of these processes over another. If I were going to make wheels, I would put them in a pit without sand, and cover the top of the pit, cover them up air-tight, this accomplishes the desired result. The result of my experience with
618 all straight-plate wheels, such as Whitney uses, is not favorable to that form of wheel. I do not know that Whitney has ever made any wheels of what is called the Washburn pattern. I never have used any wheels but what are slow-cooled by some process. The sand cooled wheels and those cooled without sand in, wear excellently well; I do not see any difference.

Cross-examination.

Ques. Have you used, on the Erie Road or elsewhere, the Lobdell wheel, made at Wilmington, Delaware?

Ans. We have used on the Erie Road both the Bush & Lobdell wheel, and the Lobdell improved wheel.

Ques. Do you use these wheels now?

Ans. We have some of them in service now.

Ques. What is the difference between the Bush & Lobdell wheel, and the Lobdell improved wheel you have mentioned?

Ans. The Bush & Lobdell wheel to which I refer, is a double-plate wheel. The Lobdell improved wheel is a single-plate wheel, strengthened by straight ribs or brackets on the inside, extending from the hub to the underside of the flange.

Ques. How do these wheels, in wear, compare with the Washburn pattern of wheels?

Ans. By our wheel records, carefully compiled, the Lobdell improved wheels are considerably inferior; as to the Bush & Lobdell, I could give no precise information, as we have applied none of them for years.

Ques. How are the Lobdell improved wheels cooled?

Ans. I do not know.

Ques. Does not the chilling of a car wheel enhance the necessity of some slow-cooling process, even beyond what would be requisite
619 from the unequal distribution of metal, if unchilled?

Ans. It is my impression that it does. It is my impression, on second thought that it does not; my reason for which is, that the chilling process, and the effect produced by it, is an instantaneous one, and it is therefore a question whether the annealing can undo any injurious effect produced by the chill.

Ques. In speaking of the Washburn pattern of wheel, do you refer to the wheel patented to Nathan Washburn, in 1850?

Ans. Yes, I do.

Subscribed and sworn to before me this 15th day of December, 1850.

U. S. circuit court, southern district of Ohio.

ASA WHITNEY
vs.
ALBERT L. MOWRY.

Charles B. Collier appeared for defendant; and Henry Baldwin, jr., for the plaintiff.

WILLIAM W. SNOW, a witness on the part of defendant, being by me first duly sworn to tell the truth, the whole truth, and nothing but the truth, deposes and says:

William W. Snow sworn, on behalf of the defendant.

Questions by Charles B. Collier, counsel for defendant.

Question. Where do you reside, and what is your occupation?

Answer. I reside in Ramapo, New York; and am a cast-iron car wheel manufacturer.

620 Ques. How long have you been engaged in the manufacture of cast-iron car wheels?

Ans. About fifteen years.

Ques. Where?

Ans. I first started in Indianapolis; I started a shop there. Fishkill and Newburgh, New York; Jersey City for several years, and in Ramapo, New York, at the present time.

Ques. Have you applied any process or processes of slow-cooling cast-iron car wheels, made by you? If so, describe such processes.

Ans. Until within the last two years and a half, I have always used sand in pits. Our present process is covering the pits over, making them as nearly air-tight as possible, without sand.

Ques. What form or forms of wheels have you made and cooled by sand, and without sand in pits?

Ans. Nearly all kinds that have been manufactured—"Washburn, or Atwood pattern; "W. W. Snow's improved;" "H. W. Moore's;" "Z. H. Mann," and what is known as the Whitney pattern; also, Lobdell's double-plate wheel, some have been double-plate and some single-plate. Whitney wheel was straight single-plate.

Ques. How extensively have you made wheels and cooled them, in the manner you have described?

Ans. I made wheels all the way from twenty to one hundred and thirty-five wheels a day.

Ques. How extensively do you manufacture and cool wheels by pitting them, without sand, at your manufactory at Ramapo, at the present time?

Ans. From one hundred to one hundred and thirty-five per day.

621 Ques. To what railroad do you sell principally?

Ans. Erie Railway; Atlantic and Great Western; Pennsylvania Central; Pittsburgh, Fort Wayne and Chicago; Central of New Jersey; New Jersey Railroad and Transportation Company, and Morris and Essex of New Jersey. These include our principal customers.

Ques. What is the character of the service on the Erie and Atlantic and Great Western roads, as compared with other roads, and the quality of wheels demanded for such service?

Ans. Their motive power being heavier than other roads, they require a better and heavier wheel. The Erie demands a heavier wheel than some roads, but there are some other roads that demand a still heavier

wheel. The Erie confines us to a wheel weighing five hundred and thirty pounds, four-inch tread, thirty-three inches in diameter. Other roads do not so confine us.

Ques. Have you had any experience with or observation as to wheels made by Whitney & Sons, of Philadelphia?

Ans. I never used any of them, and never sold any of them. I have seen them in use.

Ques. You have already stated that you manufactured, for a time, a straight single-plate Whitney wheel. Do you mean that the wheel was of the same form as that manufactured by Whitney & Sons, of Philadelphia?

Ans. It was, as near as I can tell.

Ques. How did such wheels, so made by you, answer as to wear and durability, as compared with those made by Whitney & Sons?

(Objected to.)

Ans. I can't answer that; I can tell what service they did, but I can't compare them with his.

622 Ques. How did they answer as to wear and durability, without reference to Whitney's?

Ans. They did good service; never heard of any fault found with them.

Ques. How do the wheels you now manufacture answer as to wear and durability?

Ans. They are taken as a standard of excellence by all railroad men who are acquainted with them.

Ques. Do you know the weights of the different sizes of Whitney & Sons' wheels?

(Objected to.)

Ans. I know of only one wheel I saw weighed; that was a passenger-car wheel, broad tread—4¾ inches tread—diameter 33 inches, and the weight was 631 pounds.

Cross-examined:

Ques. What do you mean by the Washburn patent?

Ans. It is a part undulating, and part double plate; a double and single plate.

Ques. Why do you call it Washburn or Atwood patent?

Ans. It is known as their invention.

Ques. Patented?

Ans. Patent has expired.

Ques. Is Moore's pattern patented?

Ans. It was known as *thribble*-plate wheel; it was patented; I don't know whether it has run out. When I made it, it was patented.

Ques. Is Mann's wheel patented?

Ans. It was patented; I believe it was; I made it as such.

623 Ques. How many wheels have you sold to the Pennsylvania Central Railroad Company?

Ans. To the best of my knowledge, about 2,500.

Ques. Have you any orders from that road now?

Ans. We have.

Ques. What weight of wheel do you supply them with?

Ans. 545 pounds.

Ques. What diameter and tread?

Ans. 33-inch diameter, and 4¾-inch tread.

Ques. Is the service on that road as exacting as on the Erie or Atlantic and Great Western?

Ans. The wheels we are supplying are entirely for passenger equipment, and in that case they may be as exacting, and perhaps even more so. I would add, the wheels we are supplying the Erie and Atlantic and Great Western are for general service—freight as well as passenger.

Ques. Do you supply the Pennsylvania Central with as good a quality of wheel as you furnish the Erie and Atlantic and Great Western?

Ans. We make but one quality; we supply the same quality to both.

Ques. Are they all the same form?

Ans. They are, excepting tread; they are all the Washburn wheel.

Ques. For what purpose was the 33-inch wheel, Whitney patent, which weighed 631 pounds, intended?

Ans. For passenger service on the Pennsylvania Central Railroad.

Ques. Where did you see it?

624 Ans. Altoona.

Ques. Was it made at Altoona?

Ans. I think it was branded as a Whitney wheel, and I think it was made by him in Philadelphia.

Ques. What process of slow cooling did you use when you made wheels in Jersey City?

Ans. Sand around the wheels, putting them in a body.

Ques. When was that?

Ans. From 1859 to 1866—fall of 1859 to spring of 1866.

Ques. When did you commence at Ramapo?

Ans. In September, 1866.

Ques. When at Fishkill and Newburgh?

Ans. In 1856–1857.

Redirect:

Question. Does the utility and value of car wheels depend, to any extent, on the form of the wheel?

Answer. It does a little. In my judgment, the main features in a car wheel consist in the quality of the iron used.

Subscribed and sworn to before me December 15, 1868.

Adjourned by consent of solicitors to Wednesday, December 16, 1868, at 11 o'clock a. m., same place.

WILLIAM KIDD, sworn on behalf of the defendant.

Questions by Cha's B. Collier, counsel for defendant:

Question. State whether or not you have at any time manufactured chilled cast-iron railroad wheels; if so, when and where, and how extensively?

625 Ans. I have manufactured them in Rochester, New York, for eighteen years; we would make from twenty-five to forty a day. The last year I ran the foundry, should think we made ten thousand wheels. I sold out to Chapin & Terry, three years ago last spring.

Ques. By what process, if any, did you anneal or slow-cool the wheels which you have testified to as having manufactured?

Ans. We pitted the wheels in a pit covered with dry sand; we would put them in red hot, and leave them there from 36 to 48 hours; usually two days.

Ques. How did the wheels so manufactured by you wear?

Ans. I thought a little better than any other wheel that ever was made. I suppose there is no better cast-iron wheel than we made. We

commenced furnishing the Western Division New York Central Railroad, at the time of the consolidation—I think in 1852—and continued up to the time I sold out, and they continue with the same establishment now.

Ques. When did you purchase the foundry where these wheels were made, and from whom?

Ans. I purchased the foundry in March, 1847, from Roswell G. Benedict.

Ques. Did Mr. Benedict manufacture cast-iron chilled wheels there, prior to the time of your purchase?

Ans. Yes; he was making them at the time I purchased the foundry.

Ques. By what process, if any, did he anneal or slow-cool the wheels made by him, at the time of your purchase?

Ans. He pitted them the same way that I did; he put them in a pit and covered them with sand. I do not know how long he kept them there.

626 Cross-examination:

Question. From March, 1847, to three years ago last spring, when you sold out, how many years do you compute?

Answer. Eighteen years.

Ques. And from three years ago last spring, to this time, how many years do you make it?

Ans. I make it twenty-one years from March, 1847, to March, 1868.

Ques. Do you fix the time at which you bought the foundry by deducting forty-seven from sixty-eight, or how, otherwise, do you fix the date?

Ans. I know the date, because I have a deed for the property. It is in 1847, I think; I would not swear positively without seeing the deed or some other memorandum.

Ques. Would you swear positively that it was in the month of March?

Ans. I think it was; when you ask me to swear positively I would rather look at the record. I think very strongly that it was in March, 1847.

Ques. What did you call the wheels you made when you first commenced?

Ans. I was making a wheel called the "Wiser wheel," a wheel patented by Wiser; we also made a double-plate wheel similar to Bush & Lobdell's; we made those up to the time we purchased the right from Washburn & Atwood; I think in 1852 or 1853; I mean we purchased the right to manufacture under Washburn & Atwood's patent.

Ques. How was the Wiser wheel cast—with a solid hub or a divided hub, or a split hub?

627 Ans. I think it had a solid hub. The double wheel, similar to Bush & Lobdell, had a solid hub. This last was called the Treadwell wheel, and was a similar wheel to that made by Eddy, of Waterford, New York.

Ques. How did you dry your sand?

Ans. As a starting point we threw sand on the hot castings; we made a large amount of miscellaneous castings. The sand would accumulate so as to give us sufficient quantity for all purposes afterwards.

Ques. You mean that the hot castings dried the sand with which you afterwards cooled the wheels?

Ans. Yes, of course; we put the sand on the hot castings for that purpose.

Ques. Of what weight did you make thirty-three inch wheels?

Ans. From five hundred to five hundred and ten pounds; we did not want them to weigh over five hundred pounds.

Ques. What was the width of tread of those wheels?

Ans. They were of the ordinary width; cannot say whether they were four or four and a half inches.

Ques. Where do you now reside?

Ans. In New York, at the Fifth Avenue Hotel.

Redirect:

Question. Did you find the annealing pits in the foundry at the time of your purchase, and did you use the pits you found there?

(Objected to as assuming that there were any annealing pits in said foundry at any time.)

Answer. I found a large pit there, divided in the centre; a pit,
628 I should think, large enough to hold from sixteen to twenty wheels.

Ques. Do you know for what length of time it had been used for annealing or slow-cooling wheels by Mr. Benedict prior to your purchase?

Ans. I do not know anything about Mr. Benedict's transaction; I saw wheels about the foundry, but never saw any in the pit under his administration; do not believe that I was ever in the foundry twice before I purchased it.

Recross:

Question. Have you designated the wheels which you have made, as annealed wheels?

Answer. Yes. The wheels were annealed wheels. The process of putting them in a pit and cooling them slowly was what we call annealing.

Ques. Did you sell them as annealed wheels?

Ans. No. I do not know whether anybody ever asked us whether they were annealed wheels. We may have been asked what our process of annealing was.

Ques. Do you ever try to make any wheels without slow-cooling them?

Ans. No; never tried it.

(Signed) WILLIAM KIDD.

Counsel for defendant having obtained from the records at Rochester, Monroe County, New York, an authenticated copy of the deed from Roswell G. Benedict to William Kidd, referred to in the deposition of said Kidd, taken before Edward Holland Nicholl, special commissioner herein, and said deed bearing date May 1st, 1847; it is agreed that May
1st, 1847, should be the date, instead of March, 1847, to which
629 said Kidd refers in his said deposition as the time of his making such purchase from Roswell G. Benedict, this date being subject to such further corrections as may be made by the witness.

ASA WHITNEY:

Question 1. Are you the said complainant?

Answer. Yes.

Ques. 2. Give the history of your invention patented April 25, 1848.

(Objected to by counsel for defendant, as not being the subject-matter of inquiry under the order of reference to the master.)

Ans. In February, 1831, I was appointed master machinist on the Mohawk and Hudson Railroad; in 1833 I was appointed general agent and superintendent of the road; I remained in charge of the road till

June, 1836; I then left the road and went into an iron establishment in Orange County, of which I was appointed superintendent and general agent; I remained there one year, till July, 1837; then I was called back on to the Mohawk and Hudson Railroad, as general agent and superintendent; I remained there till December, 1839; during all this time, while on the Mohawk and Hudson Railroad, I had a great deal of difficulty with the car wheels; they were then made with spokes, having split hubs and the hubs banded with wrought-iron; one of the great difficulties encountered was the boring and fitting the wheels to the axles, so as to remain permanently in place; the corners of the split sections of the hubs would be generally hard, so that it was difficult to bore a perfect hole so as to fit the axle; during that time I conceived the idea of making a solid hub wheel; one of the things I contemplated doing when I went to Orange County to take charge of the iron works, was to make the wheel with a solid hub; the enterprise there, of which I had charge, which was a corporation, did not succeed
630 in carrying out the objects contemplated, the main one of which was to make cast-steel directly from the ore. The stockholders failed to pay their instalments so as to enable us to prosecute the business successfully; consequently I had no opportunity of carrying out my idea of making car wheels, as contemplated when I went there. In January or February, 1840, immediately after I left the Mohawk and Hudson Railroad, I was appointed canal commissioner of the State of New York, which situation I held for two years. In June, 1842, I came to this city and formed a copartnership with M. W. Baldwin, manufacturer of locomotive engines; we manufactured the wheels for our engines and tenders in the foundry belonging to the establishment; the wheels were spoke wheels with split hubs, such as Exhibit Q, in this case; the wheel didn't give satisfaction to ourselves or our customers; I urged Mr. Baldwin—proposed to him to make the making of wheels a branch of our business, in which I intended to make the solid hub wheel, in the manner in which I subsequently did do; our business demand for engines soon afterwards became so great as to occupy all our time and attention, consequently we didn't do more at wheels than to make those for the engines we made in the old way. In February, 1846, or January, I am not sure which, I dissolved partnership with Mr. Baldwin; that summer I was employed in closing up the business of Baldwin & Whitney, and selecting a place to go into the manufacture of wheels, in which I intended to carry out my original idea of making wheels with solid hubs; in the winter of 1846 and 1847, I made patterns of wheels of three or four different forms, intending to compensate for the difference of cooling of the outside and centre of the wheel to some extent by the form of the pattern, and in case that didn't answer the purpose, to subject them to the annealing process. During February, I think it was 1847, we completed a pattern which I thought most favorable, and cast several at Mr. Baldwin's foundry, and
631 subjected them to annealing in pits constructed for the heating of wrought-iron ties to set on driving-wheels; the trials were so satisfactory that I hired a foundry in Willow street, near Thirteenth, in which I built annealing ovens of the form shown in the schedule attached to my patent; we proceeded to make wheels and subject them to annealing by the process described in the patent; I should add here that I found that the theory which I had entertained about annealing, was so satisfactory that I applied for a patent for the same, as will be shown by my letter to Dr. Jones, patent agent, at Washington. I hired the foundry in Willow street, and commenced the manufacture of wheels

in February or March, 1847; I cannot be sure as to whether it was February or March.

Ques. 3. What was the ordinary manner of cooling cast-iron car wheels prior to your commencement of the manufacture in 1847?

(Objected to by counsel for defendant, inasmuch as the witness has not testified that he was engaged prior to that time in the manufacture of cast-iron car wheels, or that he had any personal knowledge of the manner in which they were cooled outside of his own establishment.)

Ans. As far as my personal knowledge extends, wheels were made with spokes and hubs split, with spaces between the parts of the hub filled with metal and banded. As soon as cast they were taken from the moulds and cooled in the open air. As soon as they were taken from the moulds, the sand composing the core was removed from the spaces in the hubs, to allow the spokes to contract and open the spaces or splits in the hub. I have seen wheels of Lobdell's make with a double disc instead of spokes. The disc convex outwardly and the hub cut across transversely between the two plates. I believe—I don't know—but I understand they left those wheels in the moulds to cool. The model in this case, marked Exhibit "R," represents these wheels.

632 In those wheels the two sides of the disc, in cooling, would approach each other, as distinguished from the split hub in which the spaces between the hubs opened in cooling.

Ques. 4. State if you know whether any person now living assisted in or knew of the experiments made by you at Mr. Baldwin's foundry in 1847, and name some such persons, and where they reside?

Ans. The foreman of the foundry who cast the wheels, is not now living, but Mr. George Burnham, who is still in the Baldwin Locomotive Works in this city, was cognizant of the making of the pattern of the casting and annealing of the wheels. My son, Geo. Whitney, was with me and helped me to make the pattern, and knew particularly all the steps taken. The men about the shops all saw it going on, but I can't now recollect their names.

Cross:

Cross-question 1. How many wheels did you anneal at Mr. Baldwin's foundry?

Answer. I think three or four; one at a time.

Cross-ques. 2. What period of time did you occupy in making and annealing these wheels there—how many days?

Ans. I can't say how many days altogether; we cast one a day, and then the wheel would lay in the pit two or three days.

Cross-ques. 3. How large was the pit?

Ans. The pit was not suitable for the purpose—did not answer as satisfactorily as I wished—it was a little too large for one wheel, but not large enough for two; but the effort was so satisfactory as to induce me to hire a foundry and make pits more suitable for the purpose, as described in my answer to a previous question.

Cross-ques. 4. Describe the construction of the pit.

633 Ans. I think the pit was about five feet in diameter, and the outer ring of it might have been eighteen inches deep. In the centre was a raised part about thirty inches or three feet in diameter—say eight inches above the outer ring. There was grating under this outer ring, on which the fuel was placed; the wheel was put on the raised part in the centre, and as soon as the temperature was as high as we deemed to be sufficient, a cover of plate iron was placed on top to cover the whole surface of the pit. When the wheel was put in and

the cover put on, I think we covered it up with sand or dirt from about the place, to prevent the heat from escaping. Underneath this grating were openings to admit the atmosphere to support combustion.

Cross-ques. 5. What was the form of the wheels so annealed?

Ans. They were a single plate, solid hub; what we called a corrugated single-plate wheel.

Cross-ques. 6. At what temperature were they placed in the annealing pit?

Ans. They were taken from the moulds as hot as they could be moved without changing their figure. The foundry was one hundred and fifty feet, perhaps, from the annealing pit, and we had to carry them from the foundry to this pit by hand; took them on two iron bars, four men holding the four ends of the bars. The wheels when deposited in the pit were red hot.

Cross-ques. 7. What kind of fuel did you use to anneal them?

Ans. Anthracite coal. I am not sure of this; we had bituminous coal, but my opinion is we used anthracite.

Cross-ques. 8. What was done with these wheels?

Ans. We broke them up.

Cross-ques. 9. Were these the only wheels you annealed at Mr. Baldwin's foundry?

634 Ans. Yes.

Cross-ques. 10. How are you enabled to fix the date of annealing them?

Ans. I know it was in the winter of 1847—February, 1847—from the fact of our settlement for the use of tools and some materials we got from Baldwin, which were charged at that date, and settled for sometime in the spring following.

Cross-ques. 11. Have you those bills, and will you produce them?

Ans. I havn't them here. I think they are at the office.

(Complainant's counsel states that this deposition being taken at the residence of the witness, and the bills called for not being here, he proposes to introduce them at a subsequent stage of the testimony.)

Cross-ques. 12. You have stated in your examination-in-chief that you hired the foundry in Willow street, and commenced the manufacture of wheels in February or March, 1847; do you mean to say that you then commenced the annealing of wheels?

Ans. The first wheels, and all wheels we made there, were annealed. The exact date of the first wheel I cannot state here.

Cross-ques. 13. State as nearly as you can when you commenced to anneal wheels there.

Ans. I can't state exactly. I don't know that I can state more nearly than I did in a previous question. It might have been in March or April, 1847.

Cross ques. 14. Do you anneal wheels at the present time in the same manner that you did when you commenced on Willow street?

(Objected to.)

635 Ans. We anneal in the same manner that we did then, except that the furnaces are better adapted to get a uniform result. There was danger in the first furnaces of heating too hot the wheels in the bottom of the pit, and those at the top not hot enough. The intermediate wheels between the top and bottom were as well annealed as those we annealed by the improved furnaces.

Cross-ques. 15. In practical operation, what percentage of wheels did you lose by reason of the defects of which you have spoken, in the first furnaces on Willow street?

(Objected to, witness not having stated that he lost any wheels by reason of the defects, nor that there were any defects in the first furnaces.)

Ans. I couldn't tell the per cent. of loss. We had to get experience in the management of the furnaces, but we soon learned to control the heat so as to lose very few.

Cross-ques. 16. Do you apply the same degree of heat to your wheels to anneal them now that you did on Willow street?

Ans. Yes; but it is uniformly distributed through all the wheels in the pit now. It was not so easy then to heat all the wheels to the same temperature as it is in the improved furnaces.

Cross-ques, 17. State what that degree of heat is, and how near the point of fusion.

Ans. We aim to raise the temperature of all parts of the wheel up to that of the hottest part of it when taken from the mould.

Cross-ques. 18. What is the hottest part when taken from the mould?

Ans. The hub—the thickest part.

636 Cross-ques. 19. What degree indicates the fusing point of iron?

(Objected to, as not relevant, not pertinent, not competent, and not cross-examination.)

Ans. The books say about 2,700 Fahrenheit. In my own experience I have never undertaken to determine.

Cross-ques. 20. About what degree of heat have the hubs when removed from the moulds to the annealing ovens, as practised by you?

(Objected to on same grounds as preceding question.)

Ans. That I can't tell. We have no instrument to measure the temperature. We never attempted it, except by the appearance of the wheel to the eye.

Cross-ques. 21. Do you not know that it is hundreds of degrees below the fusing point?

(Objected to, same as preceding question—going into matter already disposed of by the court.)

Ans. My answer is the same as to the preceding question. We cannot measure the temperature. We never attempted it.

Cross-ques. 22. Cross-question 21 repeated.

(Objection repeated.)

Ans. I have stated that we had no means of determining. We know that it is less than fusion, because otherwise the hub would bleed, but how much I don't know.

Cross-ques. 23. Were the furnaces at your foundry on Willow street made in accordance with the diagram annexed to your letters-patent?

(Objected to as before.)

Ans. They were.

637 Cross-ques. 24. Wherein do those you now use differ from those you used on Willow street?

(Objected to as before.)

Ans. In those on Willow street the fuel was directly under the pile of wheels. In those in the furnaces we now use the heat is conveyed from the fuel through a flue to the bottom of the annealing oven in which the wheels are placed, and allowed to escape at one side of the top of the pit, above the wheels.

Cross-ques. 25. What other differences, if any, are there between the two furnaces?

(Objected to as before.)

Ans. None.

Cross-ques. 26. For how long did you use the furnaces as originally constructed?

Ans. I can't tell exactly how long, but we used them until the demand for wheels was greater than we could supply with the furnaces first built. The date of that can be ascertained at the office.

Cross-ques. 27. What change, if any, did you then make in the form of the annealing oven, and the method of introducing the heat?

Ans. The pits were made larger, so that instead of putting the wheels directly on top of each other, making a single pile, we made four piles in one pit; the fuel was introduced at the outer circumference of the inside of the pit, and on a small circular grate in the centre of the pit. There was a segment of an iron plate immediately above the fuel, under each of the four piles of wheels, to protect the lower wheel from excessive heat.

Cross-ques. 28. For how long did you use the oven so constructed?

638 Ans. Until the demand exceeded their capacity, which was, I think, about up to 1850 or 1851; the exact date can be ascertained at the office.

Cross-ques. 29. Did you change from that form to the one now in use?

(Objected to as assuming changes in form.)

Ans. The third set of annealing ovens was essentially like those we now use; their practical effect was the same. With the first set we would anneal twelve wheels a day; with the second set, I think, about sixty; with the third set, I think, about one hundred and fifty, but I am not sure of this; and with those we now use, we can anneal three hundred per day.

Cross-ques. 30. How was the heat introduced in the third set.

Ans. One fire heated two piles of wheels. The fuel was not directly under the wheels. The only object in changing from that to the present was for the convenience of the man who attends, and to enlarge the capacity of the annealing power.

Cross-ques. 31. What was the object of changing from the first form of furnace to that now employed?

(Objected to.)

Ans. I have stated, I believe, in the previous answers the object of the several changes: first, to equalize the heat more perfectly through the whole pile, and to increase the capacity of the annealing power; this was the object in changing from the first to second form; the other changes were to increase our capacity. The demand kept growing all the time, and as we rebuilt we made such changes as our experience had suggested would be beneficial.

Cross-ques. 32. In your examination, taken on the 27th day of August, 1867, before Charles Sergeant, special examiner in this case, you testified that, from 1850 to 1861, both inclusive, you were paid a dollar

639 a wheel, aside from your proportion of the profits of the business, and you annexed an exhibit to your deposition, showing the payment of two hundred and thirty-seven thousand four hundred and ninety-four dollars to you by A. Whitney & Sons; was that amount actually paid to you?

(Objected to because the witness has not so testified, but has testified that said amount was charged to the expense account of the business, and the witness is shown a copy of his said answer.)

Ans. That amount was paid as stated in the testimony then given; of course I had to bear my proportion of the dollar a wheel as an element of the expense account, like pig-iron or anything else. The firm paid me a dollar a wheel, and I was a member of the firm and had to bear my

proportion of the expenses. The rest of the dollar a wheel came to me individually. I was credited with a dollar a wheel, and if I took out cash it was debited to me.

Cross-ques. 33. What was your interest during that period in the business, and your proportion of the expenses?

Ans. My interest from 1850 to 1861, was a constantly varying one. In 1851 I had two-thirds; then I gave to my two sons, John and James, as they came of age, interests in my business.

(Complainant's counsel objects to the line of cross-examination pursued by counsel for defendant, on the ground that it has nothing to do with, nor any relevancy to, the question of the profit made by the defendant, by the use of the complainant's invention, nor with or to the question whether the wheels sold by the defendant had or could have been made to have any market value without being subjected to the process patented to the complainant, nor with or to the question whether they had or could have been made to have such value by any annealing or slow-cooling process outside of the complainant's patent,
640 nor how much additional or greater market value they derived from being subjected to said patented process; and the counsel protests against the consumption of time by such inquiries in contravention of the order of the court.)

Cross-ques. 34. Did you not, on the 4th day of February, 1862, make oath before Charles E. Pancoast, alderman of the city and county of Philadelphia, to a statement and account of your receipts and disbursements, on account of or in connection with your said letters-patent of April 25th, 1848, and did you not file such statement and account with the Commissioner of Patents at Washington, in connection with your application for an extension of said letters-patent?

(Objected to.)

Ans. Any such statement will show for itself; if I made such statement, it can be had, I suppose.

Cross-ques. 35. Will you look at the certified copy now presented to you from the Patent Office, and thus refreshing your recollection, answer the preceding question?

(Complainant's counsel inquires of defendant's counsel if he proposes to offer and put in evidence the certified copy referred to in the question. In answer to the inquiry, the defendant's counsel states that he now proposes in further cross-examination of the witness, to annex hereto the said certified copy, and to use the same upon the hearing of this case.

Complainant's counsel thereupon objects to the question, and to the introduction of said copy, and to any examination of the witness in connection therewith: 1st. As not competent, pertinent, or relevant. 2d. As not cross-examination. 3d. As a surprise upon the complainant, the defendant having closed his testimony heretofore. 4th. Because if the said statement is offered to impeach or contradict the witness, it
641 should have been offered before he was examined, touching any matter, if such there be, therein contained, pertinent or relevant, and complainant's counsel asks that the witness may have time to examine said statement, if defendant's counsel insists upon his question and purpose, but gives notice that he will move the court at or before the hearing, to direct the master to suppress the cross-examination herein so far as objected to.)

Further cross-examination of this witness adjourned to 10 o'clock a. m. of Monday, 21st inst., and examination of other witnesses adjourned to the office of A. Whitney & Sons, commencing at 4 o'clock p. m. of this day.

MONDAY, *December* 21*st*—10 a. m.

Present, Henry Baldwin, jr., for complainant; Charles B. Collier, for defendant.

Cross-examination of Asa Whitney resumed, pursuant to adjourment.

Cross-ques. 36. Cross-question 35 repeated to witness.

Ans. I made a statement with a view to getting the patent extended. The paper shown me looks to me to be a copy of it, as far as I have examined it.

Cross-ques. 37. In said statement, the following language occurs: "The cost of experiments and changes of structures for developing the improvement patented has exceeded the profits as before stated, thus:

Say, expenses	$52,970 31
Say profits	38,346 00
"Deficit	$14,624 31"

Is that correct?

(Objected to.)

Ans. That was my opinion at the time. I don't know that I have any reason to change it. That is in connection with the basis on which the account is made out.

642 Cross-ques. 38. In connection with said application for extension you filed an argument, did you not, with the Commissioner of Patents, bearing date April 1, 1862.

Ans. I did.

Cross-ques. 39. Will you look at the certified copy thereof herewith presented to you, and state whether the same is a correct and true copy?

(Objected to unless the original is produced, so that the witness can ascertain whether it is a true copy, and because, if it be a true copy of said argument, the proper way to prove it is by the production of a certified copy from the Patent Office, where it is on file.)

Ans. I can't be any more positive about it than I said in a previous question. It looks to me to be a copy of what I presented at that time, but I cannot say that it is an exact copy; I cannot say without comparing it.

Cross-ques. 40. In said argument, as shown by the certified copy thereof, the following language occurs: "Has the inventor been adequately remunerated for his time and expense in originating and perfecting it? To successfully carry out this invention, and to develop it fully, numerous and costly chambers or furnaces were to be erected. These continually required repairs, enlargement, and sometimes alterations, to carry out the process more perfectly. The applicant's account, verified by his own oath, and proven by the depositions of William Sellers and Charles Taylor, shows that he has expended $52,970 31. Selling his wheel for the same price as other manufacturers, he has saved on the 255,640 wheels made by him an average of ten pounds of metal per wheel, or 2,556,400 lbs., which, at one and one-half cents per pound, would be a saving of $38,346. His account would then be:

643	"Expenses	$52,970 00
	"Profit or saving	38,346 00
	"Deficit	$14,624 00

"Thus the applicant has failed in being reimbursed even for the

money actually expended by him, and this when the benefit he has conferred upon the public amounts to over three million dollars."

Will you now state whether the statement, as above quoted, does or does not correctly set forth your receipts or profit under said patent, or by reason thereof, for the period embraced by said statement?

(Objected to, because there is no law requiring an applicant for extension to swear to an argument, and the argument in question being based upon the accounts and proofs therein referred to, they will show for themselves the basis of the account, the details thereof, and the correctness or incorrectness of the results. Further objected to on various grounds.

Counsel for defendant offers in evidence, in connection with this deposition, certified copies from the Patent Office of the statement and account of the witness and of his argument, and of the report of the examiner, in connection with the application of the witness for an extension of his said letters-patent.

Said copy is objected to by complainant's counsel, as not being such certified copy as stated in the offer, and as being incomplete in some of its parts, and as not being certified as a copy of any paper in the matter of said application.)

Ans. My intention was, in making said application, to file a true statement, and if this is a true copy, I presume it is correct. I have no recollection of making such a statement as in Schedule "A," that the saving to the public was $2,252,636.

Cross-ques. 41. In your statement filed in connection with your application for extension, the following language occurs:

.644 "Profits.—I believe there is no essential difference in the cost per pound in making cast-iron chilled car wheels of the various patterns, and by the different modes in use, providing the same skill and system control the manufacture."

Is this now your opinion?

(Objected to.)

Ans. That is still my opinion.

Cross-ques. 42. In the statement and account filed in connection with your said application for extension of your receipts and disbursements connected with said patent, you omitted, did you not, to set forth the royalties or license fees, amounting to $237,494, paid to you by the firm of A. Whitney & Sons, as heretofore testified to by you, and a schedule of which is annexed to your deposition heretofore taken in this case and found on page 6 of the printed copy of such testimony, now exhibited to you?

(Objected to, inasmuch as said statement does not purport to contain any account of receipts, but bases the profits therein estimated upon a basis therein set forth, and not upon the basis of a difference between receipts and disbursements.)

Ans. I see no item in the paper handed me in which the cost of the wheel and the price for which they were sold is referred to. I don't see in this statement that the item of royalty could be entered; I did not deal with it at all. For the purpose for which this paper was drawn, it was not requisite to show the project I had in view. That statement has nothing to do with the profits of the wheels.

Cross-ques. 43. For what purpose was the statement and account prepared?

(Objected to.)

Ans. To show the justice of extending the patent that was then about to expire.

645 Cross-ques. 44. And yet you omitted, did you not, to set forth in said account, the payment of the royalties for the use of said patent, which you have heretofore testified to have been paid to you?

(Objected to.)

Ans. I can only repeat the answer I gave to the previous question.

Cross-ques. 45. Cross-question 44 repeated?

(Objected to.)

Ans. I repeat the same answer.

Cross-ques. 46. In your said statement, the following language occurs: "But by my process I am enabled to make them lighter than those made in any other way for a similar service, and I can, therefore, afford to sell them at the same price per wheel as the other makers, and save the cost of the d'fference in weight. This saving of metal, therefore, I deem to measure the essential advantage I have over my competitors, and also the profits arising from my patent." If you are incorrect in your hypothesis, that you are enabled by your said process to make the wheels lighter than those made for similar service, in any other way, then there is no saving or profit to the manufacturer by the use of your process, is there? If so, specify what saving or advantage there is.

Ans. The advantage that I claim for my wheel is its greater durability and safety, which gives me a large amount of business, as has been shown by the quantity we have made, as compared with other makers.

Cross-ques. 47. If those made by other makers who cool their wheels in sand or in pits, are as light as those made by you for similar service, what advantage have you over them by reason of your patented process, in the cost of manufacturing such wheels?

646 Ans. The greater safety and durability; (besides, I have always esteemed the pitting or covering the wheels with hot sand, as an invasion of my patent. It never was done, to my knowledge, until after I had commenced manufacturing and annealing the wheels as described in my patent.)

(The counsel for defendant objects to that portion of the answer included in parenthesis, as being in no way responsive to the question, and wholly incompetent for any purpose, as testimony.)

Cross-ques. 48. Cross-question 47 repeated?

Ans. I repeat my answer.

Cross-ques. 49. Under the circumstances assumed in cross-question 47, do your wheels cost more or less to manufacture, than those cooled in sand or in pits, without reference to the sale of such wheels?

(Objected to for ambiguity, inasmuch as the complainant's wheels are also cooled in pits.)

Ans. I don't think there is any essential difference in the cost of making. I don't know of any with the same system and arrangement for the manufacture as we have.

Cross-ques. 50. Have you, during the term of your patent, sold your wheels at a greater market price than those made by other manufacturers who cool them in pits with or without sand, or at a less or the same market price? And state in your answer with what manufacturer, if any, you institute the comparison.

(Objected to so far as it assumes that during the term of the patent, wheels were cooled in the pits with or without sand.)

Ans. We have always fixed the price of our wheels at as low a figure as we could afford to make them, without reference to the price
647 of other manufacturers. Our prices have generally been lower; when we first alter prices, other manufacturers immediately come

down to our prices. The only manufacturer that we compete with to any extent, is Mr. Lobdell, of Wilmington. They have in a few instances that we have known, put the price a fraction lower than ours.

Redirect:

Question 5. Does your patent of April 25th, 1848, describe the best mode known to you at the time of your application for said patent, for carrying out the process therein described?

Answer. Yes.

Ques. 6. In your application for the extension of your patent, if you had an attorney, state who it was?

Ans. I employed George Harding, of this city.

Ques. 7. Were your papers in the matter of said application, prepared according to Mr. Harding's instructions as your counsel?

Ans. They were.

Cross-examination:

Cross-ques. 51. Did you make known to Mr. Harding, before or at the time of the preparation of said papers, the fact of the payment to you of the royalties by your firm and by another licensed in Pittsburgh, which you have testified to heretofore in this case?

Ans. I do not recollect that I did.

A. WHITNEY.

648 SATURDAY, 4 *o'clock, p. m.*

Present, Henry Baldwin, jr., esq., for complainant; Charles B. Collier, esq., for defendant.

GEORGE BURNHAM.

Question 1. Please state your name, age, residence and occupation.

Answer. George Burnham; age, fifty-one; I reside in Philadelphia, 2211 Green street; I am a member of the firm of M. Baird & Co., successors to M. W. Baldwin & Co., locomotive builders.

Ques. 2. Were you at any time, and if yea, when, in the employ of M. W. Baldwin and Asa Whitney, carrying on business as Baldwin & Whitney, in Philadelphia?

Ans. I was in their employ during all the term of their copartnership, from 1842 to January or February, 1846.

Ques. 3. Look at this paper, now shown you, and say whether or not the same is in your handwriting, and if your signature is appended thereto?

Ans. It is in my handwriting, and my signature is attached to it.

Ques. 4. When did you make out and sign that bill?

Ans. The bill was made out June 25th, 1847. The receipt is signed July 2d, 1847.

Ques. 5. State, if you know, for what purpose the work and materials charged in said bill was done and furnished by you, especially that part of it under date of January 27th, 1847.

Ans. It was a machine for making a pattern or disc for car wheels.

649 Ques. 6. For whom was that work done?

Ans. Asa Whitney & Son.

Ques. 7. State, if you know, whether a pattern was made with that machine; and if yea, by whom and when?

Ans. I saw Mr. George Whitney making a pattern with the machine—cutting it out—immediately after the machine was done. Can't say exactly when it was, but it must have been in January or February, 1847.

Ques. 8. You say that work was done for A. Whitney & Son. When did that firm commence business?

Ans. Well, I don't know when the copartnership of A. Whitney & Son was formed, but they were certainly in copartnership in June, 1847.

Ques. 9. Did you see any car wheels cast from the pattern last spoken of; and if yea, when and where?

Ans. I saw them at our shop, sometime in the first six months of 1847. My impression is, it was considerably before the first of May. I refer to the following entry in my handwriting in the books of M. W. Baldwin. Memorandum following an entry of May 10th as follows:

"Trial of experiment with patent wheel, moulding, casting, cooking and breaking up five wheels, at four dollars each,..... ....$20 00

"One wheel cast, 380 lbs., at 3 cts.,..... 11 40"

The marginal memorandum is as follows:

"1 or 2 wheels; 3 or 4 do; 1 cooked; all broken up."

I recollect that the foreman was not certain, at the time this entry was made, as to the number of wheels that we had experimented with. This is the reason for my believing that it must have been sometime prior to the date of this entry, because if it had been within a month, he would have known the number.

650 Ques. 10. Did you see anything done, in the way of experiment, with the wheels cast from said pattern; and if yea, what was it?

Ans. I don't recollect seeing anything done with the wheels cast from that pattern. I saw the wheel broken up. I saw pieces of them after they were broken up.

Ques. 11. When was that?

Ans. It was in the early part or middle of 1847, between January and July, 1847. I recollect there was a difficulty about making the thickness Mr. Whitney desired in the disc; it was a corrugated and curved disc.

Ques. 12. Do you know what is meant, in the entry above quoted, by the words "cooking" and "breaking up" five wheels, or "1 cooked."

Ans. They were annealed after they were cast; that was the annealing.

Ques. 13. Did you see the cooking or annealing of those wheels, or did you know of it?

(Last clause of question objected to, as calling for hearsay testimony.)

Ans. I don't recollect seeing it; I knew of it, however.

Ques. 14. How did you know of it?

Ans. I knew that—at least that was our impression and practice—that wheels could not be cast solid; they were cast in the ordinary way, the hubs cut, and they were filled in and branded afterwards. The wheels we made, I mean, were cut-hub wheels, and these were cast solid. I also knew by the entry just referred to by me, that they were annealed.

Ques. 15. Were you book-keeper for M. W. Baldwin at the time you testify of?

Ans. I was.

651 Ques. 16. Had you anything to do with the foundry work, except making entries in the books?

Ans. I had not.

The bill referred to by the witness is put in evidence, annexed hereto, and marked by the commissioner, "G. B."

Cross-question 1. When was the entry made in the books, as to which you have testified?

Answer. It is under date of June 30th, 1847; there is an item May 6th, $8 80, and May 10th, $2 65, and one of $1 66; then occurs the item

which was for the wheels, breaking up, annealing, and trial of experiments with patent wheel, all under entry of June 30th; the foreman brought his book in—brought something in—a memorandum, from which I made the entries for the first six months of the year; the entries just above extend from April 26th to June 12th.

Cross-ques. 2. In this entry is the item under May 6th, "To turning disc for wheel pattern $2\frac{2}{10}$ days, at $4, $8 80." Were the wheels, referred to in the subsequent part of said entry, made from said pattern?

Ans. I think not.

Cross-ques. 3. Do you know that they were not?

Ans. I know that there were several different paterns made or cast.

Cross-ques. 4. When was the marginal entry made which is quoted in your examination-in-chief, viz: "1 or 2 wheels; 3 or 4 do.; 1 cooked; all broken up?"

Ans. Made at the time the charge was made, I presume; I have not seen the book since the entry was made; I mean I have not examined the book, or that particular entry; that was in June, 1847.

652 Cross-ques. 5. Do you mean to testify, as of your own knowledge, that either of said wheels were "cooked" prior to the time, as stated in the charge made upon the books?

Ans. Yes, I think they were cast and annealed during the winter or spring of 1847, at different times, to ascertain the thickness of the disc.

Cross-ques. 6. Did you see either one of the wheels referred to cooked or annealed?

Ans. I can't say that I did see them in the annealing pits or furnace.

Cross-ques. 7. Then, of your own knowledge, you do not know that they were annealed or cooked, do you?

Ans. Yes, I think I do know that they were annealed; I can't say that I actually saw them put into the furnace or taken out; I knew by their condition that they had been annealed.

Cross-ques. 8. Will you look at the book of M. W. Baldwin, under date December 31st, 1847, and see what charge, if any, there is against Asa Whitney & Son as of that date?

Ans. I see a charge for two axles and fitting up two pair of wheels, with the word "estimate" in brackets, $50 80. 1½ days, turning and boring disc, part of same entry, at $4—$6.

Redirect:

Question 17. Have the entries under date of June 30th, 1847, in M. W. Baldwin's book, or the entry of December 31st, 1847, anything to do with your bill of June 25, 1847?

Answer. No, sir; that is an individual bill of my own.

(Counsel for defendant desires the commissioner to enter an objection to the entire deposition of Mr. Burnham, as not being responsive to any question addressed to the master under the order of the court.)

GEO. BURNHAM.

653 CHARLES T. PARRY:

Question 1. Please state your name, age, residence, and occupation.

Answer. Charles T. Parry; age, forty-seven; residence, 1711 Green street, Philadelphia; I am a machinist.

Ques. 2. Please state the name and style under which you carry on business.

Ans. I am a member of the firm of M. Baird & Co., locomotive builders, successors to M. W. Baldwin.

(Copy.)

EXHIBIT G. B.

PHILADELPHIA, *June 25th*, 1847.

Asa Whitney & Son to George Burnham, Dr.

Jan. 27.	To 14 lbs. forging, 12½c., $1 75., piece 11 lbs., $1 12, and splicing, 25c., (of Murphy)	$3 12
	Stuff for table, $2 28, 3 9/10 days, making table, $3 90.	6 18
	Work by Siukler, making machine, fitting to table and altering, 18 days, at $2 00 per day	36 00
	8 days' assistance, by Alfred, at 75c	6 00
	Shaft for upright drum, 41 lbs., at 6c	2 46
	2¾ lbs. steel for mandril, 77c., brass box 27c., belt $1 25	2 29
	Steel for cutters, 6 lbs., $1 08, washers, $1 01	2 09
May 1.	To fitting up cast-iron machine and fitting mandril, and work at tools, 4 days, at $2	8 00
	12 lbs. iron 36c., drilling and tapping 52 plates $1 75.	2 11
	Carried forward	$68 25
654	Brought forward	$68 25
May 11.	To 2 bolts and nuts 90c., cross-bar $2, (of Kleize)	2 90
	Face plate 32 lbs, at 4c	1 28
	Fitting face plate, and mandril and tools, 4 days, at $2	8 00
		$80 43

Received payment, July 2, 1847.
(Signed) GEO. BURNHAM.

Ques. 3. Were you in business with or employed by M. W. Baldwin; and if yea, during what time?

Ans. I have been there a great many years; have been in the employ of M. W. Baldwin; Baldwin, Vail & Hufty; Baldwin & Vail; Baldwin & Whitney; M. W. Baldwin, and M. W. Baldwin & Co. I have been there since 1836.

Ques. 4. During what period did the firm of Baldwin & Whitney exist?

Ans. My impression is from 1844 to 1847; I can't say exactly the years.

Ques. 5. Was the Whitney of said firm this complainant, Asa Whitney?

Ans. Asa Whitney was the partner of Mr. Baldwin in that firm.

Ques. 6. Did you know, at any time, of any experiments made by said Whitney, in the manufacture of cast-iron car wheels; and if yea, when?

(Objected to by counsel for defendant, as being not now a question before the master.)

Ans. I knew there were such experiments made, and it was in the spring of 1847, to the best of my knowledge, immediately after the retiring of Mr. Whitney from the firm.

655 Ques. 7. In what did his experiments at that time consist?

Ans. They consisted in making a car wheel with curved, corrugated disc—solid hub.

Ques. 8. Did he make such wheels?

Ans. Such wheels were made in the works for Mr. Whitney by M. W. Baldwin, from patterns made and constructed for the most part by Mr. George Whitney.

Ques. 9. Describe any treatment to which said wheels were subjected, after being cast?

(Objected to for same reason as heretofore.)

Ans. They were taken from the chill in the foundry at a high heat; as high as they could bear handling, and placed in a furnace temporarily prepared for the purpose; there was a fire previously made in the furnace; the wheels were then placed in this furnace, covered with fine coal, cinders, &c.; a mixture of blacksmith's coal and cinders; my impression is that the fire was heated up afterwards, to raise the temperature of the wheel after being put in; all the draft was then shut off, the fire smothered, and the wheel allowed to remain in there until cool; it may be for two or three days. I cannot say positively that the first wheel was not cracked by shrinkage, but I know that some of them were not. The process was considered a success at that time, in casting a solid hub wheel.

Ques. 10. When the wheel was placed in the furnace and covered over with fine coal, cinders, &c., as you have described, was anything put over the top of the furnace?

Ans. I don't remember that there was. The wheel was covered entirely by this coal. It is my impression there was two feet of it. This was done for the purpose of retaining the heat.

Ques. 11. Can you state when Mr. George Whitney made the patterns from which these wheels were cast?

656 Ans. In the spring of 1847.

Ques. 12. Can you state how soon after the pattern was made the wheels were annealed as you have described?

Ans. I cannot say the exact time. It was one process right straight along—the patterns were made, wheels cast, and annealed.

Ques. 13. Can you state in what month?

Ans. No, sir; I cannot say.

Cross:

Cross-question 1. What had George Whitney to do with the making and annealing of these wheels, if anything?

Answer. He seemed to have the charge of it pretty much. He and his father were together; he worked and fixed the patterns.

Cross-ques. 2. Did he suggest the annealing of them in the manner you have described?

(Objected to.)

Ans. I don't know that he did.

Cross-ques. 3. Who did?

Ans. I don't know that; the work was done under directions of Whitney & Son.

Cross-ques. 4. What other process, if any, of annealing, was applied to car wheels at the foundry of Mr. Baldwin at the time of which you have testified?

Ans. No other.

Cross-ques. 5. Did you see the wheels being annealed in the manner you have described?

Ans. Yes, sir; I saw them.

Cross-ques. 6. You have stated that they were placed in a furnace temporarily prepared for the purpose. Will you describe such furnace?

657

Ans. The furnace was of circular form, built for the purpose of heating tire-hooping wheels. It had a centre in it for the purpose of forming an annular space, in which the tire was heated. For the purpose of making this wheel, we took the centre out, forming an oven. The furnace itself was furnished with grates and air flues underneath, so that the fire could be made. It was partially above, partially under the ground. The whole depth from the bottom of the air-flue to top of the furnace was about thirty inches. I think the inner diameter was about four feet.

Cross-ques. 7. On what did the wheels rest when placed in this furnace?

Ans. On the coals of fire previously made.

Cross-ques. 8. On what did the coals rest?

Ans. The coals rested partially on the grates and the brickwork, when the centre was removed from it. The grate was from sixteen to eighteen inches from the bottom of the air-flue.

Cross-ques. 9. Where was the outer end of the air-flue; how, if at all, was the supply of air regulated?

Ans. It connected with a blast pipe, and the supply was regulated by means of a valve. The valve was on the outer wall of the furnace.

Cross-ques. 10. Was the wheel, or any part of it when placed in the furnace, above the surface of the ground?

Ans. I think the wheel was all above the surface of the ground.

Cross-ques. 11. Was it, or any part of it, above the top of the oven?

658

Ans. I think not; the oven was sufficiently deep to take in a wheel twelve inches.

Cross-ques. 12. Was the coal or cinders placed around the wheel, as well as on top of it?

Ans. It was. The wheel was, so to speak, packed in them.

Cross-ques. 13. What kind of coal was used?

Ans. I am not sure; I think it was bituminous. The stuff that was put on there was considered a kind of waste. There was some anthracite, some bituminous. There was sufficient coal in the covering to make a very hot fire if needed, but that was not done in this case.

Cross-ques. 14. How hot was the fire?

Ans. It was not sufficiently hot to melt cast-iron. The amount of heat was, of course, regulated by the Messrs. Whitney to suit their idea.

Cross-ques. 15. Was the supply of air or draught continued during all the time the wheel was in the oven?

Ans. No, sir; I am not positive how long it continued, but Mr. Whitney told me at the time that the purpose was to raise the heat of the wheel slightly above what it was when it was put in.

Cross-ques. 16. Do you know about what temperature the hottest part of the wheel was when put into the oven; if so, will you please state it?

Ans. I know that it was red hot, but cannot say now whether it was a light red or a dark red.

Cross-ques. 17. Can you approximate as to how far or how many degrees it was below the point of fusion?

Ans. No; I am not sufficiently versed in temperatures to express it by degrees. My impression is that a red heat is from 800 to 1,000 degrees.

CHA'S T. PARRY.

659 At the request of counsel for defendant, the further examination of witnesses noticed for this day, is adjourned to Tuesday, the 22d day of December, between the hours of ten o'clock a. m., and ten o'clock p. m., at the office of Whitney & Sons.

All objection by reason of the same being taken at that time, being waived by counsel for defendant.

TUESDAY, *December* 22—10 *a. m.*

Present, Henry Baldwin, jr., for complainant; Chas. B. Collier, for defendant.

GEORGE H. KIRK:

Question 1. Please state your name, age, residence, and occupation.

Answer. George H. Kirk; age, thirty-five; reside, 1528 Brown street, Philadelphia; occupation, book-keeper for A. Whitney & Sons.

Ques. Have you prepared or had prepared under your supervision, a tabulated transcript from the books of A. Whitney & Sons, of car wheels sold by them from 1861 to 1868, and of the persons to whom they were sold; and if yea, will you please produce the same to be annexed hereto?

Ans. I have prepared such statement, and herewith produce the same; it covers the period from January 1st, 1861, to December 12th, 1868, inclusive.

Ques. 3. Is the same a true and correct statement, according to the best of your knowledge and belief?

Ans. It is.

(Statement put in evidence and marked "Exhibit G. H. K.")

660 Cross-examined:

Cross-question 1. Were all of these wheels sold directly from your establishment in this city?

Answer. They were, to the best of my knowledge and belief.

Cross-ques. 2. Were any commissions paid by the firm to any one for making such sales of wheels?

Ans. Yes, sir.

Cross-ques. 3. On how many wheels have commissions been paid?

Ans. I cannot tell.

Direct resumed:

Ques. 4. Please designate the names on said list to whom commissions have been paid.

Ans. Williams and Page; those are the only parties I have any knowledge of.

GEO. H. KIRK.

Affirmed to and subscribed before me, this 22d day of December, A. D. 1868.

W'M B. DAYTON,
Notary Public and Special Commissioner.

Examination adjourned to 4 o'clock p. m., of this day.

DECEMBER *22d*—4 *p. m.*

Present, Henry Baldwin, jr., for complainant; Chas. B. Collier, for defendant.

Complainant's counsel states that he has no further witnesses to produce, and this examination is adjourned sine die.

661 *Purchasers of Whitney & Sons' wheels, from January 1st, 1861, to December 12th, 1868.*

Purchasers.	1861.	1862.	1863.	1864.	1865	1866.	1867.	1868.	Totals.
Abbott & Cortright	.....	208	56	.....	.....	.....	.....	.....	264
Augusta & Savannah Railroad Company	33	.....	.....	.....	.....	.....	.....	.....	33
Allegheny Valley Railroad Company	37	111	152	220	258	16	.....	.....	794
Atkins Bros	.....	48	4	.....	4	76	46	44	222
Androscoggin Railroad Company	.....	20	.....	.....	.....	.....	.....	.....	20
Ashenfender, J	.....	8	14	.....	.....	.....	4	.....	26
Architectural Iron Works	.....	24	8	32	.....	.....	.....	.....	64
Allentown Iron Company	.....	1	2	8	.....	.....	.....	2	13
Adams' Express Company	.....	.....	32	.....	.....	18	39	10	99
Atlantic & Great Western Railroad Company	.....	.....	80	854	450	.....	.....	.....	1,384
Anspach & Sons	.....	.....	.....	.....	36	.....	.....	.....	36
Ainsworth, J. H	.....	.....	.....	.....	4	.....	.....	.....	4
Atlantic Works	.....	.....	.....	.....	.....	32	.....	.....	32
Alabama & Tennessee River Railroad Company	.....	.....	.....	.....	.....	72	.....	.....	72
Atlanta & W. Pt. Railroad Company	.....	.....	.....	.....	.....	174	124	.....	296
Altland, S	.....	.....	.....	.....	.....	20	14	.....	34
Alexandria, London & Hampshire Railroad Co	.....	.....	.....	.....	.....	4	12	.....	16
Alabama & Florida Railroad Company, of Ala	.....	.....	.....	.....	.....	40	294	16	350
Allison, W. C	.....	.....	.....	.....	.....	.....	313	71	384
Allison, W. C. & Sons	.....	.....	.....	.....	.....	.....	.....	124	124
Acker, John	.....	.....	.....	.....	.....	.....	2	.....	2
Acadia Coal Company	.....	.....	.....	.....	.....	.....	.....	200	200
Anderson, S	.....	.....	.....	.....	.....	.....	.....	4	4
Averill Coal & Oil Company	.....	.....	.....	.....	.....	.....	.....	60	60
American Dredging Company	.....	.....	.....	.....	.....	.....	.....	4	4
Baldwin, M. W. & Co	494	802	1,146	1,689	1,284	1,400	782	.....	7,597
Baird, M. & Co	.....	.....	.....	.....	.....	.....	599	946	1,545
Bellefontaine Railroad Line	514	1,312	1,237	672	118	.....	.....	.....	3,853
Billmeyer & Small	1,040	878	206	2	416	989	1,528	.....	5,059
Beaver Meadow Railroad & Coal Company	232	394	1,072	885	.....	.....	.....	.....	3,083
Bancroft, Lewis & Co	103	156	300	91	125	86	66	82	1,009
Bradley, O., agent	.....	.....	.....	.....	.....	.....	.....	.....	.....
Carried forward	2,453	4,462	4,309	4,453	2,695	2,925	3,823	1,563	26,683
662 Brought forward	2,453	4,462	4,309	4,453	2,695	2,925	3,823	1,563	26,683
Belvidere, Delaware & Flemington Railroad Co	.....	.....	.....	100	196	66	.....	.....	274
Boston & Providence Railroad Company	104	40	12	.....	218	.....	.....	.....	462
Boston & Lowell Railroad Company	50	30	.....	.....	110	.....	.....	.....	190
Bement & Dougherty	.....	.....	.....	.....	.....	.....	66	.....	66
Bangor, Oldtown & Milford Railroad Company	.....	36	.....	.....	2	18	.....	.....	56
Boston & Maine Railroad Company	.....	50	300	200	300	260	.....	.....	1,110
Bolton, J. R	573	553	208	84	.....	.....	.....	.....	1,418
Buffalo St. Railroad Company	8	.....	.....	.....	.....	.....	8	.....	16
Bellefonte & Snow Shoe Railroad Company	.....	30	12	42	85	68	52	55	344
Burlington & Mt. Holly Railroad Company	.....	8	8	.....	.....	.....	.....	.....	16
Barclay Coal Company	.....	10	180	.....	.....	8	2	.....	200
Bittelman, William	.....	6	.....	.....	.....	.....	.....	.....	6
Butler Coal Company	.....	.....	.....	400	.....	.....	.....	.....	400
Baker & Henrici	.....	.....	.....	280	16	.....	.....	10	306
Brooke, E. & G	.....	.....	.....	.....	3	19	.....	.....	22
Bolton, Dykeman & Co	.....	.....	.....	122	240	743	.....	.....	1,105
Boston & Lowell and Nashua & Lowell Railroad Co	.....	.....	150	.....	.....	.....	.....	.....	150
Bartholomew, B	.....	.....	.....	.....	4	.....	.....	.....	4
Burlington County R. & T. Co	.....	.....	.....	.....	2	14	.....	.....	16
Brua, S. M. & Co. } Brua, S. M. & Bros. }	.....	.....	.....	.....	58	.....	.....	.....	58
Bradley, O	62	.....	.....	.....	404	100	.....	.....	566
Buck, D	.....	.....	.....	.....	12	.....	.....	.....	12
Bird, G. M. & Co	.....	.....	.....	.....	9	.....	.....	.....	9
Blair, T. P	.....	.....	.....	.....	4	.....	.....	.....	4
Bender, J. E	.....	.....	.....	.....	8	2	.....	.....	10
Bethlehem Iron Company	.....	.....	.....	.....	4	.....	.....	.....	4
Batdorff, Z	.....	.....	.....	.....	56	544	.....	.....	600
Bruner & Moore	.....	.....	.....	.....	1	.....	.....	.....	1
Carried forward	3,250	5,225	5,179	5,681	4,427	4,767	3,951	1,628	34,108
663 Brought forward	3,250	5,225	5,179	5,681	4,427	4,767	3,951	1,628	34,108
Beelem & Bros	.....	.....	.....	.....	.....	16	.....	.....	16
Black Heath Coal Company	.....	.....	.....	.....	.....	24	.....	.....	24

Purchasers of wheels—Continued.

Purchasers.	1861.	1862.	1863.	1864.	1865.	1866.	1867.	1868.	Totals.
Blair, A. H	.....	.....	.....	.....	.....	2	4	.....	6
Broad St., Navy Yard & Fairmount Pass. R. W. Co	.....	.....	.....	.....	4	38	.....	.....	42
Blair Iron & Coal Company	.....	.....	.....	.....	.....	32	32	48	112
Boyd, Thomas G	.....	.....	.....	.....	.....	4	.....	.....	4
Brua & Bricka	.....	.....	.....	.....	.....	8	.....	.....	8
Bryson, T. B	.....	.....	.....	.....	.....	.....	2	.....	2
Brennan, T. M. & Bro	.....	.....	.....	.....	.....	.....	12	.....	12
Baltimore & Ohio Railroad Company	.....	.....	.....	.....	.....	.....	18	.....	18
Boston, Hartford & Erie Railroad Company	.....	.....	.....	.....	.....	.....	72	28	100
Bennington & Rutledge Railroad Company	.....	.....	.....	.....	.....	.....	.....	40	40
Billmeyer & Smalls	.....	.....	.....	.....	.....	.....	.....	396	396
Bitner & Bros	.....	.....	.....	.....	.....	.....	.....	2	2
Buffalo Bayou, Brazos & Colorado Railroad Co	.....	.....	.....	.....	.....	.....	.....	256	256
Central Railroad & B'g Co., (Ga.)	.....	.....	.....	.....	.....	720	970	322	2, 112
Central Ohio Railroad Company	378	464	398	506	244	.....	.....	.....	1, 990
Columb. & Indianapolis Railroad Line	40	140	128	80	.....	.....	.....	.....	388
Castor, Tho's	.....	22	8	16	.....	.....	.....	.....	46
Central Railroad Company of New Jersey	75	188	.....	.....	6	.....	.....	.....	269
Cape Cod Railroad Company	40	40	42	.....	40	20	.....	12	194
Cumberland Coal & Iron Company	.....	8	22	20	114	30	112	28	334
Concord, Manchester & Lawr. Railroad Co	.....	200	420	100	24	.....	.....	.....	744
Camden & Atlantic Railroad Company	28	116	150	.....	.....	.....	.....	.....	294
Connecticut & Passumpsic Rivers Railroad Co	40	100	250	220	500	100	100	.....	1, 310
Cooke, W'm & Co	24	.....	.....	.....	.....	.....	.....	.....	24
Cumberland Valley Railroad Company	36	112	48	84	.....	98	60	.....	438
Craig & Koch	158	.....	.....	.....	.....	.....	.....	.....	158
Coliseo Railroad Company	74	56	148	.....	100	.....	.....	.....	378
Carried forward	4, 143	6, 671	6, 793	6, 707	5, 459	5, 859	5, 333	2, 760	43, 725
664 Brought forward	4, 143	6, 671	6, 793	6, 707	5, 459	5, 859	5, 333	2, 760	43, 725
Catawissa Railroad Company	126	326	244	.....	76	.....	.....	.....	772
Clayton, H	2	.....	.....	.....	.....	.....	.....	.....	2
Clapp, Galen	480	.....	.....	.....	.....	.....	.....	.....	480
Citizens' Passenger Railway Company, Philadelphia	58	22	78	64	56	62	46	76	462
Casebolt, H. & Co	120	152	100	52	76	116	212	140	968
Cleveland & Pittsburgh Railroad Co	56	190	1, 467	1, 784	973	5	.....	.....	4, 475
Chicago, Burl. & Quincy Railroad Company	680	.....	120	.....	.....	.....	.....	.....	800
Chicago and Rock Island Railroad Company	.....	300	120	80	.....	.....	.....	.....	500
Chicago & Milwaukie Railroad Company	.....	8	.....	.....	.....	.....	.....	.....	8
Cummings, W'm & Son	.....	64	.....	.....	40	180	270	.....	554
Cleveland & Toledo Railroad Company	.....	40	12	.....	.....	.....	.....	.....	52
Cleveland & Mahoning Railroad Company	.....	50	200	.....	.....	.....	.....	.....	250
Catasauqua & Fogelsville Railroad Company	.....	8	.....	24	.....	.....	.....	.....	32
Cleveland, Col. & Cincinnati Railroad Company	.....	6	.....	.....	.....	.....	.....	.....	6
Cook, J. M	.....	.....	10	.....	.....	.....	.....	.....	10
Coleman, Moses	.....	.....	24	.....	.....	.....	.....	.....	24
Cumberland & Pennsylvania Railroad Company	.....	.....	36	.....	.....	.....	.....	.....	36
Cape Island City Passenger Railway Company	.....	.....	14	.....	.....	.....	.....	.....	14
Carbon Iron Company	.....	.....	32	.....	50	46	.....	.....	128
Cape May & Millville Railroad Company	.....	.....	.....	.....	8	22	.....	.....	30
Carson, Geo. C. & Co	.....	.....	8	.....	.....	.....	.....	.....	8
Chestnut Hill Iron Ore Company	.....	.....	.....	40	24	24	48	92	228
Cheshire Railroad Company	.....	.....	.....	50	.....	.....	.....	.....	50
Consolidated Coal Company	.....	.....	.....	440	40	.....	.....	.....	480
Calais & Baring Railroad Company	.....	.....	.....	16	.....	.....	.....	.....	16
Columb. & Ind. Central Railroad Company	.....	.....	.....	.....	572	159	.....	.....	731
Cornell & Hendry	.....	.....	.....	.....	2	.....	8	.....	10
Coleman, W. T. & Co	.....	.....	.....	.....	.....	160	100	.....	260
Clark, Richard	.....	.....	.....	.....	.....	5	.....	.....	5
Carried forward	5, 665	7, 837	9, 258	9, 257	7, 376	6, 638	6, 017	3, 068	55, 116
665 Brought forward	5, 665	7, 837	9, 258	9, 257	7, 376	6, 638	6, 017	3, 068	55, 116
Carothers, J. S	.....	.....	.....	.....	.....	.....	2	.....	2
Charlotte & S. C. Railroad Company	32	.....	.....	.....	.....	60	.....	.....	92
Cheraw & Darlington Railroad Company	.....	.....	.....	.....	.....	40	.....	.....	40
Citizens' Passenger Railway Company, Pittsburgh	.....	.....	.....	.....	.....	16	.....	.....	16
Cameron, Barkley & Co	.....	.....	.....	.....	.....	.....	52	.....	52
Cambria Iron Company	.....	.....	.....	.....	.....	.....	28	24	52
Chester Manufacturing Company	.....	.....	.....	.....	.....	.....	8	.....	8

Purchasers of wheels—Continued.

Purchasers.	1861.	1862.	1863.	1864.	1865.	1866.	1867.	1868.	Totals.
Carter, Allen & Co							18	17	35
Casebolt, Crittenden & Co							108		108
Cape Cod Central Railroad Company							8		8
Coal Ridge Impr. & Coal Company								172	172
Cresson & Smith								8	8
Crescent City Railroad Company								24	24
Cardenas & Jucaro Railroad Company								32	32
Cameron, Geo. S								14	24
Danforth, Cooke & Co	12	20							32
Detroit & Milwaukee Railroad Company		284						8	292
Dickson & Co	4								4
Dickson Manufacturing Company		4	12	6	51	24	100	48	294
Dickson, Stewart & Co	13	10		63	20	40			146
Dawson Manufacturing Co						80	216	80	376
Delaware, Lackawanna, & Western Railroad Co					16				16
Denny & Hess					4	16	2	46	68
Dewitt, Kettle & Co					80				80
Carried forward	5,726	8,155	9,270	9,326	7,547	6,914	6,559	3,551	57,048
666 Brought forward	5,726	8,155	9,270	9,326	7,547	6,914	6,559	3,551	57,048
Dungan, C. B					4				4
Danforth Locomotive & Machine Company						12		36	48
Dykeman & Co						32			32
Dooiittle, F. A							12		12
East Pennsylvania Railroad Company	32	32					262	76	402
East Tennessee & Georgia Railroad Company	56					16	4	40	116
Eckert, R. S			8						8
Elmira & Williamsport Railroad Company	50	164							214
Evansville & Crawford Railroad Company		64					272	248	584
Eastern Railroad Company					150	80		100	330
Erie & Pittsburgh Railroad Company					6				6
Empire Transportation Company					32			400	432
Esterly & Reilly						2			2
Eagle, S. F., & Son							12		12
Eldridge & Farewell							160		160
East Tennessee & Virginia Railroad Company								10	10
Fairhaven Branch Railroad Company		32							32
Fairhaven Railroad Company	12		12	20	44	44	44	24	200
Fairhaven & Westville Railroad Company					44	24	48	36	152
Fairmount Passenger Railway Company	40	73	72	70	36				291
Fallon, Henry F		8							8
Fairmount & Arch Street Passenger Railway Co	40	32	56	37					165
Frankford & Southwark P. C. Passeng'r Railway Co	119	103	179	156	196	231	372	294	1,650
Frick, G. L. & N	16								16
Fry & Thompson		44	24						68
Fegely, Isaac					67	18	12		97
Carried forward	6,091	8,707	9,621	9,609	8,126	7,373	7,757	4,815	62,099
667 Brought forward	6,091	8,707	9,621	9,609	8,126	7,373	7,757	4,815	62,099
Fatzinger, A. H. & Co					2				2
Flanders, J. P. & Co					96				96
Fowle & Co						150			150
Flagler & Brother							121		121
Fisher, J. L							12		12
Frederick & Co							10	7	17
Frymier, J								4	4
Foldy, W'm								8	8
Gardiner & Co. F	24	34	36	58	52	132	174	78	588
Galena & Chicago Un. Railroad Company	1,058	600	200						1,838
Germantown Passenger Railroad Company	42								42
Gibson & Palmer			80						80
Gipson, J. C. & Co	34								34
Goold, James & Co	30		32						62
Girard College Passenger Railway Co	28	40	56	54	56	50	52	64	400
Green and Coates Streets Passenger Railway Co	25	72	59	96	76	80	103	109	620
Grice & Long	22	94	92	177	213	300	267	224	1,319
Great Western Railroad Company of 1859	100	200	467	170					937
Grand Trunk Railway Company, of Canada	100								100
Great Central Railroad Company			235	16					251
Great Central Railroad Line				358					358
Greer & Brother					6	2	4	6	18
Garrett, E					50	62			112
Galveston City Railroad Company								28	28
Garrett, Kent & Co								44	44

Purchasers of wheels—Continued.

Purchasers.	1861.	1862.	1863.	1864.	1865.	1866.	1867	1868.	Totals.
Gilbert, Bush & Co	.....	.....	.....	.....	.....	.....	.....	16	16
Hanover Branch Railroad Company	8	.....	.....	.....	4	28	16	26	82
Harlan, Hollingsworth & Co	272	188	.....	.....	4	132	.....	112	708
Hartford & New Haven Railroad Company	50	4	.....	8	4	12	11	4	93
Carried forward	7, 864	9, 869	10, 878	10, 546	8, 689	8, 321	8, 527	5, 545	70, 239
668 Brought forward	7, 864	9, 869	10, 878	10, 546	8, 689	8, 321	8, 527	5, 545	70, 239
Harrisburg Car Company	16	172	175	90	.....	.....	.....	.....	453
Harrisburg Car Manufacturing Company	.....	.....	.....	.....	25	80	22	16	143
Haskell & Barker	.....	600	1, 440	500	.....	.....	.....	.....	2, 540
Hathaway & Leach	11	.....	.....	.....	.....	.....	.....	.....	11
Havana City Railroad Company	.....	40	.....	.....	.....	.....	.....	.....	40
Heathcote, Herbert & Co	.....	168	90	.....	.....	.....	.....	.....	258
Hess, J. G	.....	2	5	.....	.....	.....	.....	.....	7
Hestonville, Mantua & Fairm'nt Pass'ger Rail'y Co	.....	.....	55	54	132	110	180	138	669
Hinckley, Holmes	61	.....	.....	.....	.....	.....	.....	.....	61
Hinckley, Williams & Co	.....	20	178	319	36	.....	.....	.....	553
Hinckley Williams Works	.....	.....	.....	.....	232	41	.....	.....	273
Hoopes & Townsend	80	.....	.....	.....	.....	.....	.....	.....	80
Howard Express Company	19	.....	.....	.....	.....	.....	.....	.....	19
Howard & Co	.....	18	66	105	71	88	12	.....	360
Horton, John	.....	.....	80	.....	.....	.....	.....	.....	80
Hunter, F. S. & Bro	.....	12	.....	.....	.....	.....	.....	.....	12
Hunter, Nicholas	.....	.....	.....	.....	.....	12	12	20	44
Hull, Corlies & Co	.....	.....	40	.....	.....	.....	.....	.....	40
Hanway & Co	.....	.....	16	64	.....	.....	.....	.....	80
Hammett, Van Dusen & Lochman	.....	.....	24	48	.....	.....	.....	.....	72
Huntington & Broadtop Railroad Company	.....	.....	.....	72	.....	.....	.....	50	122
Harberger, McCully & Co	.....	.....	.....	.....	5	.....	1	.....	6
Honey Brook Coal Company	.....	.....	.....	.....	144	204	154	276	778
Hummell, G	.....	.....	.....	.....	8	.....	.....	.....	8
Hasler & Son	.....	.....	.....	.....	2	.....	.....	.....	2
Carried forward	8, 051	10, 901	13, 047	11, 798	9, 344	8, 856	8, 908	6, 045	76, 950
669 Brought forward	8, 051	10, 901	13, 047	11, 798	9, 344	8, 856	8, 908	6, 045	76, 950
Hoffman & Spahn	.....	.....	.....	.....	9	5	6	2	22
Hartford & Weathersf. Horse Railroad Company	.....	.....	.....	.....	16	.....	.....	.....	16
Hale & Co	.....	.....	.....	.....	4	.....	.....	.....	4
Holman, L	.....	.....	.....	.....	4	.....	.....	.....	4
Hursh, J. & J. B	.....	.....	.....	.....	.....	10	6	.....	16
Hoover, S. M	.....	.....	.....	.....	.....	8	8	.....	16
Hibernia Mine Railroad Company	.....	.....	.....	.....	24	40	.....	.....	64
Havana Railroad Company	.....	.....	.....	.....	.....	.....	100	.....	100
Henshall, John & Co	.....	.....	.....	.....	.....	4	4	.....	8
Hawman, H. R	.....	.....	.....	.....	.....	10	18	80	108
Houston & Texas Central Railway Company	.....	.....	.....	.....	.....	.....	640	600	1, 240
Hathaway, Charles	.....	.....	.....	.....	.....	.....	8	.....	8
Hazleton Railroad Company	.....	.....	.....	.....	.....	.....	.....	1, 600	1, 600
Hyltons, S. C	.....	.....	.....	.....	.....	.....	.....	4	4
Ilgenfitz & White	73	706	791	73	92	.....	.....	.....	1, 735
Ilgenfitz, G. W. & Co	.....	.....	.....	.....	.....	324	68	.....	392
Ilgenfitz & Schall	.....	.....	.....	.....	.....	.....	85	.....	85
Indiana Central Railroad Company	.....	20	.....	.....	.....	.....	.....	.....	20
Ind. Central, Dayton & Western Railroad Company	.....	169	.....	.....	.....	.....	.....	.....	169
Indianapolis & Madison Railroad Company	.....	48	20	.....	.....	.....	.....	.....	68
Imbrie, A. S	.....	.....	.....	.....	4	.....	.....	.....	4
Jeffersonville Railroad Company	.....	90	460	264	160	.....	.....	.....	974
Jessup, M. K. & Co	.....	24	.....	.....	.....	.....	.....	.....	24
Junction Railroad Company	.....	.....	48	.....	.....	.....	.....	.....	48
Jones & Laughlins	48	16	.....	.....	.....	.....	.....	.....	64
Johnson, J. & Sons	.....	.....	.....	.....	.....	2	4	4	10
Jackson & Sharp	.....	.....	.....	.....	.....	.....	60	.....	60
Jeamby, A	.....	.....	.....	.....	.....	.....	4	.....	4
Carried forward	8, 172	11, 974	14, 366	12, 135	9, 657	9, 259	9, 919	8, 335	83, 817
670 Brought forward	8, 172	11, 974	14, 366	12, 135	9, 657	9, 259	9, 919	8, 335	83, 817
Kimball & Gorton	30	.....	.....	.....	.....	.....	.....	.....	30
Kitzmiller, Stees & Co	2	.....	.....	.....	.....	.....	.....	.....	2
Kennebec & Portland Railroad Company	52	52	92	30	.....	.....	.....	.....	226
Kleisz, H	1	.....	.....	.....	.....	.....	.....	.....	1
Kauffelt, H	48	2	68	.....	.....	.....	.....	.....	118
Kentucky Central Railroad Company	.....	4	.....	.....	.....	.....	.....	.....	4

Purchasers of wheels—Continued.

Purchasers.	1861.	1862.	1863.	1864.	1865.	1866.	1867.	1868.	Totals.
Kraft, G. & W	.....	.....	.....	14	.....	.....	.....	.....	14
Kinsman, J	.....	.....	.....	.....	.....	32	.....	.....	32
Kinsman Street Railroad Company	.....	.....	.....	.....	30	.....	.....	.....	30
Knoxville & Kentucky Railroad Company	.....	.....	.....	.....	.....	.....	4	.....	4
Kershaw & Hunt	.....	.....	.....	.....	.....	.....	24	25	49
Keith, J. & Son	.....	.....	.....	.....	.....	.....	560	800	1,360
Keystone Co-operative Mach. Manufacturing Co.	.....	.....	.....	.....	.....	.....	12	.....	12
Kotteamp, J. F. & H	.....	.....	.....	.....	.....	.....	24	.....	24
Kauffman Iron Company	.....	.....	.....	.....	.....	.....	26	.....	26
Kingston Lumber Company	.....	.....	.....	.....	.....	.....	.....	16	16
Lackawanna & Bloomsburg Railroad Company	130	92	8	18	216	168	138	12	782
Lafayette & Indianapolis Railroad Company	.....	100	209	213	259	54	.....	.....	835
Lehigh Crane Iron Company	92	112	78	38	194	104	.....	.....	618
Lehigh Coal & Navigation Company	680	12	938	1,756	1,804	3,758	3,162	4,400	16,510
Lehigh Valley Railroad Company	556	927	502	291	1,322	3,629	2,110	788	10,125
Lehigh & Susquehanna Railroad Company	.....	.....	6	.....	.....	.....	.....	.....	6
Lewis, John T. & Bros	12	50	18	10	.....	.....	.....	.....	90
Leesport Iron Company	.....	12	.....	.....	.....	.....	.....	.....	12
Lexington & W. Camb. Railroad Company	.....	.....	8	.....	.....	.....	.....	.....	8
La Crosse & Milwaukee Railroad Company	.....	125	.....	.....	.....	.....	.....	.....	125
Little Miami, Col. & Xenia Railroad Company	.....	1,348	560	.....	.....	.....	.....	.....	1,908
Logansport, Peoria & Burlington Railroad Co	.....	4	.....	.....	.....	.....	.....	.....	4
Carried forward	9,775	14,814	16,853	14,505	13,482	17,004	15,979	14,376	116,788
671 Brought forward	9,775	14,814	16,853	14,505	13,482	17,004	15,979	14,376	116,788
Louisville, Frankfort & Lexington Railroad Co	.....	12	.....	.....	.....	.....	.....	.....	12
Louisville & Nashville Railroad Company	.....	8	.....	12	.....	.....	.....	.....	20
Louisv'e & Frankf't, Lexington & Frankf't R. R. Co	.....	.....	112	148	250	170	12	.....	692
Louisville, N. Albany & Chicago Railroad Company	.....	36	72	95	.....	.....	.....	.....	203
Lyon & Vose	50	.....	.....	.....	.....	.....	.....	.....	50
Lykens Valley Railroad Company	.....	.....	10	.....	.....	4	.....	.....	14
Lambard, Thos	.....	.....	32	368	.....	40	.....	.....	440
Laughlin & Co	.....	.....	.....	2	.....	.....	.....	.....	2
Lehigh & Mahanoy Railroad Company	.....	.....	.....	.....	674	424	.....	.....	1,098
Lobdel, George G	.....	.....	.....	.....	4	.....	.....	.....	4
Lombard & South Streets Passenger Railway Co	.....	.....	18	50	26	40	25	34	193
Lanigan, James	.....	.....	.....	.....	.....	.....	40	24	64
Leeds & Co	.....	.....	.....	.....	.....	.....	4	.....	4
Little Saw Mill Run Railroad Company	.....	.....	.....	.....	.....	.....	.....	8	8
Low, A. A. & Bros	.....	.....	.....	.....	.....	.....	.....	100	100
Light & Uhler	.....	.....	.....	.....	.....	.....	.....	4	4
Manasses Gap Railroad Company	46	.....	.....	.....	.....	.....	.....	.....	46
Madison & Indianapolis Railroad Company	32	.....	.....	.....	.....	.....	.....	.....	32
Matthews & Moore	12	.....	.....	4	.....	.....	.....	.....	16
Merrick, Hanna & Co	.....	.....	56	.....	24	.....	.....	.....	80
Merrick & Sons	.....	.....	.....	.....	.....	8	4	.....	12
Millville & Glasboro' Railroad Company	4	.....	4	.....	.....	.....	.....	.....	8
Michigan, Southern & Northern Indiana R R. Co	340	200	4	464	594	24	.....	.....	1,626
Millholland, James	.....	.....	800	.....	.....	.....	.....	.....	800
Morris Canal & B. Company	100	100	100	80	120	72	128	100	800
Carried forward	10,359	15,170	18,061	15,728	15,174	17,786	16,192	14,646	123,116
672 Brought forward	10,359	15,170	18,061	15,728	15,174	17,786	16,192	14,646	123,116
Morton, C. P. & Co	12	.....	.....	.....	.....	.....	.....	.....	12
Mowton, G. & Co	8	36	141	50	.....	.....	.....	.....	235
Morley, R. F., A.D. & Supt. U. S. Mil. R. R'ds.	.....	4	.....	.....	.....	.....	.....	.....	4
Murphy & Allison	339	1,070	401	69	230	327	16	.....	2,452
Muscogee Railroad Company	32	.....	.....	.....	200	40	140	26	438
Mobile & Girard Railroad Company	.....	.....	.....	.....	60	192	16	32	300
Moul, C	.....	.....	8	8	.....	8	.....	.....	24
Meily, John	.....	.....	.....	100	.....	.....	.....	.....	100
Meiley, Weimer & Co	.....	.....	.....	31	415	417	16	.....	879
Maine Central Railroad Company	.....	.....	.....	24	204	60	.....	.....	288
Martin, B. B. & Sons	.....	.....	.....	8	.....	.....	.....	.....	8
McLane, Charles S	.....	.....	.....	.....	4	.....	.....	.....	4
Maxwell, H. & Co	.....	.....	.....	.....	12	.....	8	.....	20
Manchester Locomotive Works	.....	.....	.....	12	196	151	81	73	513
Murray, Dougal & Co	.....	.....	.....	.....	80	10	.....	.....	90
Morris, L P., Towne & Co	.....	.....	.....	.....	8	4	.....	14	26
McKay & Aldus	.....	.....	.....	.....	76	.....	.....	24	100

Purchasers of wheels—Continued.

Purchasers.	1861.	1862.	1863.	1864.	1865.	1866.	1867.	1868.	Totals.
Mississippi Central Railroad Company	.....	.....	.....	.....	110	24	48	.....	182
Montgomery Iron Company	.....	.....	.....	.....	4	68	65	.....	137
Montgomery & Co	.....	.....	.....	.....	.....	12	28	20	60
Montgomery & West Point Railroad Company	.....	.....	.....	.....	.....	692	140	96	928
Miller, D	.....	.....	.....	.....	.....	4	.....	.....	4
Maltby & Case	.....	.....	.....	.....	.....	13	5	.....	18
McGarvey, J. A	.....	.....	.....	.....	.....	4	.....	.....	4
Macon & Brunswick Railroad Company	.....	.....	.....	.....	.....	16	72	.....	88
Montgomery & Enfal. Railroad Company	.....	.....	.....	.....	.....	80	132	24	236
Maltby, C. S	.....	.....	.....	.....	.....	.....	2	2	4
Carried forward	10, 750	16, 780	18, 611	16, 030	16, 773	19, 908	16, 961	14, 957	130, 270
673 Brought forward	10, 750	16, 280	18, 611	16, 030	16, 773	19, 908	16, 961	14, 957	130, 270
Macon & Western Railroad Company	.....	.....	.....	.....	.....	.....	248	154	402
Mobile & Ohio Railroad Company	.....	.....	.....	.....	.....	.....	.....	130	130
Morris & Essex Railroad Company	.....	.....	.....	.....	.....	.....	.....	100	100
Marianno Railroad Company	.....	.....	.....	.....	.....	.....	.....	64	64
Mumper, A. L. & Co	.....	.....	.....	.....	.....	.....	.....	45	45
Matanzas Railroad Company	.....	.....	.....	.....	.....	.....	.....	78	78
New Bedford & Taunton Railroad Company	.....	.....	20	50	62	120	94	84	430
New Orleans & Carrollton Railroad Company	8	.....	.....	.....	28	.....	.....	24	60
New York & Harlem Railroad Company	295	202	230	.....	.....	.....	.....	.....	727
New York, Providence & Boston Railroad Co	.....	.....	80	60	50	.....	.....	.....	190
North Pennsylvania Railroad Company	119	149	214	151	237	328	676	506	2, 380
Northern Railroad Company, (N. H.)	100	287	391	342	278	300	130	220	2, 048
Northern Central Railway Company	.....	220	403	1, 388	1, 719	557	391	550	5, 288
Norfolk County Railroad Company, (Trust)	48	20	.....	.....	.....	.....	.....	.....	68
Norwich & Worcester Railroad Company	30	.....	200	100	.....	185	15	.....	530
Norris, Richard & Son	64	392	290	586	218	106	.....	.....	1, 656
Norris Brothers	.....	.....	.....	.....	399	161	56	.....	616
Norris, E. S	.....	.....	.....	.....	.....	.....	4	2	6
Norris Company	.....	.....	.....	.....	.....	.....	.....	78	78
New Jersey Locomotive & Machine Company	.....	.....	.....	78	14	71	126	.....	289
New London Northern Railroad Company	.....	.....	.....	.....	60	.....	.....	.....	60
North Carolina Railroad Company	.....	.....	.....	.....	100	.....	.....	40	140
New Brighton Iron Car Company	.....	.....	.....	.....	.....	48	8	.....	56
North Eastern Railroad Company	.....	.....	.....	.....	.....	584	62	119	765
Niagara Street Railroad Company	.....	.....	.....	.....	.....	32	20	.....	52
Nashville & Decatur Railroad Company	.....	.....	.....	.....	.....	48	72	24	144
New Orleans & Ohio Railroad Company	.....	.....	.....	.....	.....	4	.....	.....	4
Nichol, Doolittles & Mann	.....	.....	.....	.....	.....	16	.....	.....	16
North Lebanon Railroad Company	.....	.....	.....	.....	.....	2	2	.....	4
New Orleans, Jackson & G. N. Railroad Company	.....	.....	.....	.....	.....	.....	60	.....	60
Carried forward	11, 414	17, 550	20, 439	18, 785	19, 938	22, 470	18, 925	17, 175	146, 696
674 Brought forward	11, 414	17, 550	20, 439	18, 785	19, 938	22, 470	18, 925	17, 175	146, 696
Niblo, J. M	.....	.....	.....	.....	.....	.....	.....	48	48
North, J. H	.....	.....	.....	.....	.....	.....	.....	4	4
New Orleans City Railroad Company	.....	.....	.....	.....	.....	.....	.....	96	96
Orange & Alexandria Railroad Company	75	.....	.....	.....	.....	.....	.....	.....	75
Old Colony & Fall Railroad Company	54	154	196	.....	320	.....	.....	.....	794
Old Colony & Newport Railroad Company	.....	.....	.....	362	140	188	.....	.....	690
Ohio & Mississippi Railroad Company	216	529	1, 290	674	30	182	158	20	3, 099
Ottawa & Prescott Co	60	.....	.....	.....	.....	.....	.....	.....	60
Oram, H. C. & Co	.....	.....	.....	20	.....	.....	.....	.....	20
Ogden Mine Railroad Company	.....	.....	.....	.....	.....	200	24	212	436
Offutt, M'Onerney & Co	.....	.....	.....	.....	.....	.....	385	.....	385
Orange, Alexandria & Manassa Railroad Company	.....	.....	.....	.....	.....	.....	.....	272	272
Ogdensburgh & Lake Champlain Railroad Co	.....	.....	.....	.....	.....	.....	.....	50	50
Pardee, A. & Co	.....	4	12	8	12	4	4	.....	44
Paulick, McCulley & Harberger	.....	4	46	2	.....	.....	.....	.....	52
Petersburg Railroad Company	100	.....	.....	.....	164	.....	.....	20	284
Pennsylvania Railroad Company	6, 416	13, 489	11, 606	14, 799	10, 350	11, 760	12, 508	11, 536	92, 464
Pennock, S. M. & Co	28	772	160	124	.....	.....	.....	.....	1, 084
Penn'a R. R. Co., (lessees Phil'a & Erie R. R. Co.)	.....	742	1, 826	1, 106	868	414	179	8	5, 143
Penn. Gas Coal Company	.....	12	16	1, 844	196	.....	461	219	2, 748
Philadelphia & Reading Railroad Company	20	3, 490	164	4, 705	1, 865	550	503	736	12, 033
Philadelphia, Germantown & Norristown R. R. Co	110	88	194	126	217	258	298	236	1, 527
Philadelphia & Gray's Ferry Passenger Railway Co	37	12	18	40	43	72	62	48	332
Philadelphia City Passenger Railway Company	60	24	24	60	18	55	94	116	451
Philadelphia & Darby Passenger Railway Company	.....	.....	32	8	31	18	16	16	121

Purchasers of wheels—Continued.

Purchasers.	1861.	1862.	1863.	1864.	1865.	1866.	1867.	1868.	Totals.
Philadelphia & Erie Railroad Company	2	.....	.....	.....	.....	.....	.....	.....	2
Philadelphia & Eastern Transportation Company	.....	.....	.....	236	.....	.....	.....	.....	236
Phœnix Iron Company	.....	.....	.....	.....	.....	24	100	16	140
Carried forward	18, 592	36, 870	36, 023	42, 899	34, 192	36, 195	33, 717	30, 828	239, 316
675 Brought forward	18, 592	36, 870	36, 023	42, 899	34, 192	36, 195	33, 717	30, 828	269, 316
Pittsburgh, Fort Wayne & Chicago Railway Co	78	3, 002	4, 125	2, 945	1, 212	40	8	100	11, 510
Pittsburgh, Columbus & Cincinnati Railroad Co	.....	.....	.....	436	.....	.....	.....	.....	436
Pittsburgh, Allegheny & Manchester Railroad Co	26	56	49	84	86	27	25	.....	353
Pittsburgh & Connellsville Railroad Company	.....	61	30	60	40	16	.....	.....	207
Pittsburgh, Columbus & Cincinnati Railroad Line	6	230	524	.....	298	.....	.....	.....	1, 058
Pittsburgh & McKeesport Car Company	.....	.....	.....	.....	40	.....	104	.....	144
Powelton Coal & Iron Company	.....	.....	22	42-97	160	130	72	.....	523
Providence & Stonington Railroad Company	32	56	.....	.....	.....	.....	.....	.....	88
Providence & Worcester Railroad Company	100	202	225	405	50	100	.....	.....	1, 082
Prevost, A. G. M	.....	60	.....	.....	.....	.....	.....	.....	60
Prentiss, E. F. & Co	117	50	.....	.....	.....	.....	.....	.....	167
Parrish & Co	.....	.....	4	316	.....	.....	.....	.....	320
Parrish & Thomas	.....	.....	.....	.....	.....	296	28	.....	324
Portland & Kennebec Railroad Company	.....	.....	.....	53	230	118	56	.....	457
Portland, Sara. & Portsm. Railroad Company	.....	.....	.....	15	135	.....	40	.....	190
Pennock, S. & Co	.....	.....	.....	.....	400	.....	14	.....	414
Prichett, B	.....	.....	.....	.....	2	.....	.....	.....	2
Pensacola & Georgia Railroad Company	.....	.....	.....	.....	16	64	.....	.....	80
Paige, D. H	.....	.....	.....	.....	.....	480	.....	.....	480
Pendleton Street Railroad Company	.....	.....	.....	.....	.....	40	86	.....	126
Peabody & McDonald	.....	.....	.....	.....	.....	228	.....	32	260
Paine, J	.....	.....	.....	.....	.....	4	.....	.....	4
Phleger & Davidson	.....	.....	.....	.....	.....	.....	8	.....	8
Perkins, Livingston & Post	.....	.....	.....	.....	.....	.....	80	74	154
Powers & Weightman	.....	.....	.....	.....	.....	.....	8	2	10
Peoria, Pekin & Jackson Railroad Company	.....	.....	.....	.....	.....	.....	.....	82	82
Providence, Warren & Bristol Railroad Company	.....	.....	.....	.....	.....	.....	.....	16	16
Pennock, Samuel	.....	.....	.....	.....	.....	.....	.....	4	4
Prentice & Fitler	.....	.....	.....	.....	.....	.....	.....	4	4
Quirk, John B	.....	.....	.....	.....	.....	8	.....	.....	8
Carried forward	18, 951	40, 587	41, 002	47, 352	36, 861	37, 746	34, 246	31, 142	287, 887
676 Brought forward	18, 951	40, 587	41, 002	47, 352	36, 861	37, 746	34, 246	31, 142	287, 887
Raritan & Delaware Bay Railroad Company	.....	10	.....	.....	.....	.....	.....	.....	10
Richmond & Schuylkill Passenger Railway Co	12	20	26	23	.....	.....	.....	.....	81
Ridge Avenue & Manayunk Passenger Railway Co	4	30	30	32	32	24	26	.....	178
Rogers' Locomotive & Machine Works	80	24	18	4	.....	.....	.....	56	182
Roberts, A. & P. & Co	496	9	44	.....	12	28	20	.....	609
Rodenhausen, L	2	.....	.....	.....	.....	.....	.....	.....	2
Rosch, John & Co	.....	40	.....	.....	.....	.....	.....	.....	40
Rome, Watertown & Ogd. Railroad Company	.....	.....	4	1	2	.....	.....	.....	7
Romans W	.....	.....	.....	8	.....	.....	.....	.....	8
Rhoads, J. & D	.....	.....	.....	2	2	.....	.....	.....	4
Renngron, W	.....	.....	.....	2	.....	.....	.....	.....	2
Ranlet Manufacturing Company	.....	.....	.....	.....	8	.....	.....	.....	8
Reading & Col. Railroad Company	.....	.....	.....	.....	42	76	40	48	206
Richmond, Fred. & Pet. Railroad Company	24	.....	.....	.....	122	115	.....	26	287
Ruby, H. & Co	.....	.....	.....	.....	2	2	.....	.....	4
Rome Railroad Company	.....	.....	.....	.....	.....	5	.....	.....	5
Raleigh & Gaston Railroad Company	.....	.....	.....	.....	.....	136	32	108	276
Raoul, Sons & Wadley	.....	.....	.....	.....	.....	236	1, 148	48	1, 432
Rhode Island Locomotive Works	.....	.....	.....	.....	.....	.....	32	.....	32
Richmond & Petersburg Railroad Company	.....	.....	.....	.....	.....	.....	24	52	76
Richmond & Danville Railroad Company	.....	.....	.....	.....	.....	.....	8	.....	8
Railroad Car Trust—Philadelphia	.....	.....	.....	.....	.....	.....	.....	2, 496	2, 496
Sandusky, Dayton & Cincinnati Railroad Co	.....	143	238	237	187	.....	.....	.....	805
Sandusky, Mansf. & Newark Railroad Company	.....	204	.....	.....	.....	.....	.....	.....	204
Second & Third Streets Passenger Railway Co	4	212	146	222	213	234	192	293	1, 516
Sellers, William & Co	22	120	159	200	87	123	127	206	1, 044
Sener, G. & Sons	.....	.....	48	2	2	.....	.....	.....	52

Purchasers of wheels—Continued.

Purchasers.	1861.	1862.	1863.	1864.	1865	1866.	1867.	1868.	Totals.
Schenectady Locomotive Works	.....	.....	156	10	32	157	.....	24	379
Seventeenth & Nineteenth Streets Pass. Rail'y Co	2	56	8	26	20	26	66	26	230
Shaaber, Daniel	.....	32	8	.....	14	5	.....	.....	347
Carried forward	19, 597	41, 775	41, 887	48, 121	37, 638	38, 913	35, 961	34, 525	298, 417
677 Brought forward	19, 597	41, 775	41, 887	48, 121	37, 638	38, 913	35, 961	34, 525	298, 417
Shawnee Iron Works	.....	.....	72	.....	.....	.....	.....	.....	72
Smith, William	.....	4	.....	4	2	.....	.....	.....	10
Snyder, G. W	.....	.....	.....	.....	.....	.....	1	.....	1
Snyder, J. A	.....	2	.....	.....	4	.....	2	1	9
South Carolina Railroad Company	94	.....	.....	.....	86	588	1, 060	594	2, 352
Southern Railroad Company, (Mississippi)	24	.....	.....	.....	.....	.....	244	.....	268
Shamokin Valley & Pottsville Railroad Company	.....	8	.....	.....	.....	.....	.....	.....	8
Sterns, J. O	.....	6	.....	.....	.....	.....	.....	.....	6
Stephenson, John	.....	.....	228	.....	.....	96	.....	.....	324
Schuylkill Navigation Company	.....	.....	.....	890	88	.....	.....	.....	978
Schafhirt, A. F	.....	.....	.....	2	.....	.....	.....	.....	2
Struthers, J., & Son	.....	.....	.....	4	.....	.....	.....	.....	4
Swede Iron Company	.....	.....	.....	.....	16	30	30	1	77
Salem Car Company	.....	.....	.....	.....	42	32	.....	.....	74
Sharpe, E	.....	.....	.....	.....	24	.....	.....	.....	24
Schafhirt, Imbire & Co	.....	.....	.....	.....	4	.....	.....	.....	4
Snyder, H	.....	.....	.....	.....	4	4	4	2	14
St. Franc & Alameda Railroad Company	.....	.....	.....	.....	30	.....	.....	.....	30
Serrill, J. S	.....	.....	.....	.....	20	.....	.....	.....	20
Scott Foundry	.....	.....	.....	.....	1	.....	.....	.....	1
Singeiser & Brandt	.....	.....	.....	.....	2	.....	.....	.....	2
Seirer & Angle	.....	.....	.....	.....	8	.....	.....	.....	8
Snyder & Newcombe	.....	.....	.....	.....	2	.....	.....	.....	2
Shamokin Coal Company	.....	.....	.....	.....	24	.....	.....	.....	24
Shamoken & Bear Valley C. Company	.....	.....	.....	.....	.....	22	.....	.....	22
Stone, Quigley & Burton	.....	.....	.....	.....	3	.....	.....	.....	3
Shelmire, D., & Co	.....	.....	.....	.....	.....	.....	.....	2	2
Stearns, Whitney & Bridges	.....	.....	.....	.....	10	8	.....	.....	18
Southwestern Railroad Company	.....	.....	.....	.....	136	288	65	120	1, 200
Sener & Bro	.....	.....	.....	.....	.....	4	.....	.....	4
Carried forward	19, 715	41, 795	42, 187	49, 021	38, 144	39, 985	37, 958	35, 175	303, 980
678 Brought forward	19, 715	41, 795	42, 187	49 021	38, 144	39, 985	37, 958	35, 175	303, 980
Scully, F	.....	.....	.....	.....	.....	2	.....	.....	2
Simons, H	.....	.....	.....	.....	.....	22	.....	.....	22
Sims, F. W. & Co	.....	.....	.....	.....	.....	128	.....	.....	128
Salkeld, J. H. & Co	.....	.....	.....	.....	.....	2	.....	.....	2
Shelmire, D., & Co	.....	.....	.....	.....	.....	2	.....	.....	2
Summit Branch R. R. Company	.....	.....	.....	.....	.....	.....	35	46	81
Scranton & Prov. Pass. Railway Company	.....	.....	.....	.....	.....	.....	8	.....	8
Selma, Rome, & Dalton R. R. Company	.....	.....	.....	.....	.....	.....	240	24	264
Sands, W. L., & Co	.....	.....	.....	.....	.....	.....	.....	120	120
St. Charles N. R. R. Co., (N. O.)	.....	.....	.....	.....	.....	.....	.....	20	20
Seaboard & Roanoke R. R. Company	.....	.....	.....	.....	.....	.....	.....	188	188
Stayman & Bucher	.....	.....	.....	.....	.....	.....	.....	18	18
Shott, John H., & Co	.....	.....	.....	.....	.....	.....	.....	8	8
Selma & Merid. R. R. Company	.....	.....	.....	.....	.....	.....	.....	44	44
Star Iron Company	.....	.....	.....	.....	.....	.....	.....	12	12
Steinover & Fry	.....	.....	.....	.....	.....	.....	.....	2	2
Schall, M	.....	.....	.....	.....	.....	.....	.....	.....	.....
Southern R. R. Association	.....	.....	.....	.....	.....	.....	.....	464	464
Spring Mountain Coal Company	.....	.....	.....	.....	.....	.....	.....	40	40
Terre Haute & Richmond R. R. Company	160	250	310	390	100	.....	.....	.....	1, 210
Tioga R. R. Company	12	86	676	777	285	234	210	308	2, 588
Thomas Iron Company	178	218	246	105	76	48	.....	.....	871
Taunton Locomotive Manufacturing Company	8	.....	.....	.....	64	48	.....	.....	120
Tomlinson, J	89	113	158	109	.....	.....	.....	.....	469
Tomlinson, J., & Son	.....	.....	.....	.....	122	160	105	88	475
Trenton Locomotive & Manufacturing Company	84	.....	.....	.....	.....	.....	.....	.....	84
Terre Haute, Alton & St. Louis R. R. Company	.....	10	.....	.....	.....	.....	.....	.....	10
Toledo, Wabash, & Western R. R. Company	.....	8	.....	.....	.....	.....	.....	.....	8
Thirteenth & Fifteenth Streets Pass Railway Co	.....	.....	6	54	57	16	70	58	261
Thayer, Erdman, Wilson & Co	.....	.....	32	.....	.....	.....	.....	.....	32
Carried forward	20, 246	42, 480	43, 615	50, 456	38, 848	40, 647	38, 626	36, 615	311, 533

Purchasers of wheels—Continued.

Purchasers.	1861.	1862.	1863.	1864.	1865.	1866.	1867.	1868.	Totals.
679 Brought forward	20,246	42,480	43,615	50,456	38,848	40,647	38,626	36,615	311,533
Thomas, G. W. & Co's lessees	.....	.....	4	18	4	36	54	10	126
Trenton Horse Railroad Company	.....	.....	.....	8	6	14	4	10	42
Toledo, Peoria & Warsaw Railroad Company	.....	.....	.....	.....	50	.....	.....	.....	50
Towanda Coal Company	.....	.....	.....	.....	.....	700	.....	28	728
Toronto Street Railroad Company	.....	.....	.....	.....	.....	.....	10	20	30
Torbert, Wm. B	.....	.....	.....	.....	.....	.....	.....	4	4
Trost, Wm. F	.....	.....	.....	.....	.....	.....	.....	4	4
Union Transportation Line	.....	.....	12	564	.....	.....	.....	.....	576
United States	.....	.....	40	462	658	.....	.....	.....	1,160
Urbano Railroad Company, Havana	.....	.....	120	.....	.....	.....	.....	.....	120
Union Passenger Railway Company, Phila	.....	.....	.....	.....	32	195	182	148	557
Union Foundry Company	.....	.....	.....	.....	.....	.....	.....	40	40
Vermont & Massachusetts Railroad Company	.....	.....	.....	.....	70	.....	.....	.....	70
Virginia Central Railroad Company	.....	.....	.....	.....	232	100	.....	.....	332
Vicksburg & Meridian Railroad Company	.....	.....	.....	.....	.....	.....	16	.....	16
Williams & Page	8	.....	.....	.....	16	188	1	.....	213
West Philadelphia Passenger Railway Company	100	114	112	160	169	120	168	120	1,063
Wharton, W. Jr	.....	4	.....	.....	.....	.....	.....	.....	4
Wallace & Breisch	4	8	.....	.....	.....	.....	.....	.....	12
Wise, Thomas	2	2	.....	.....	.....	.....	.....	.....	4
West Chester & Philadelphia Railroad Company	12	.....	.....	.....	.....	.....	.....	18	30
Wisler, H. H	4	.....	.....	.....	.....	4	2	.....	10
Westmoreland Coal Company	1,600	.....	.....	808	.....	.....	.....	400	2,808
Wood, Morrell & Co	8	.....	.....	.....	.....	.....	.....	.....	8
Weson Manufacturing Company	.....	8	.....	.....	.....	.....	.....	.....	8
Washington & Georgetown Passenger Railway Co	.....	60	28	.....	.....	.....	.....	.....	88
Wessel, A	.....	100	2,012	.....	.....	.....	.....	.....	2,112
Carried forward	21,984	42,776	45,943	52,476	40,085	42,004	39,063	37,417	321,748
680 Brought forward	21,984	42,776	45,943	52,476	40,085	42,004	39,063	37,417	321,748
Whitney & Bridges	.....	.....	20	.....	.....	.....	.....	.....	20
Wood, J. & Bros	.....	.....	2	2	.....	.....	.....	.....	4
Washington Iron Works	.....	.....	.....	.....	.....	80	.....	.....	80
Western Maryland Railroad Company	.....	.....	.....	8	.....	.....	.....	.....	8
White, Thos	.....	.....	.....	.....	80	16	.....	.....	96
White & Gartman	.....	.....	.....	.....	.....	68	.....	.....	68
Worthington & Akens	.....	.....	.....	.....	2	.....	.....	.....	2
Wilkesbarre Coal & Iron Company	.....	.....	.....	.....	6	12	10	20	48
Wilmington, Charlotte & Ruth. R. R. Co	.....	.....	.....	.....	36	92	36	8	172
Wilmington & Weldon Railroad Company	.....	.....	.....	.....	310	327	263	303	1,203
Wilmington & Manchester R. R. Co	.....	.....	.....	.....	.....	1,040	.....	.....	1,040
Woodward, H. M	.....	.....	.....	.....	16	.....	.....	.....	16
Woodward, R. C	.....	.....	.....	.....	2	.....	.....	2	4
Western & Atlantic Railroad Company	.....	.....	.....	.....	140	486	276	260	1,162
West Jersey Railroad Company	.....	.....	.....	.....	.....	78	.....	4	82
Witmer, S. H	.....	.....	.....	.....	.....	80	.....	.....	80
Western Central R. R. & Great Western Railway Company, lessees Catawissa R. R	.....	.....	.....	.....	73	264	61	17	415
Welsh, S & W	.....	.....	.....	.....	.....	32	.....	.....	32
Whitner, H. K	.....	.....	.....	.....	.....	.....	2	.....	2
Wright, E	.....	.....	.....	.....	.....	.....	16	.....	16
Wunderlich & Read	.....	.....	.....	.....	.....	.....	6	.....	6
Wenner, P. S. & Bros	.....	.....	.....	.....	.....	.....	126	246	372
Williams, Page & Co	.....	.....	.....	.....	.....	.....	.....	4	4
Watteon & Clark	.....	.....	.....	.....	.....	.....	.....	48	48
Washington, Alexandria & Georgetown R. R Co	.....	.....	.....	.....	.....	.....	.....	12	12
Young Bros	.....	.....	.....	.....	80	.....	.....	.....	80
Union Car Works	22	.....	.....	.....	.....	.....	.....	.....	22
Carried forward	22,006	42,776	45,965	52,486	40,830	44,579	39,859	38,341	326,842
681 Brought forward	22,006	42,776	45,965	52,486	40,830	44,579	39,859	38,341	326,842
Fall Brook Coal Company	108	166	624	156	320	251	152	8	1,785
Greenville & Col. Railroad Company	4	.....	.....	.....	.....	.....	.....	.....	4
Sturtevant, N. & Co	20	.....	.....	.....	.....	.....	.....	.....	20
Seltzer, C. A & A. M	80	.....	.....	.....	.....	.....	.....	.....	80
Springfield, Del. & Lakeville R. R. Co	10	.....	.....	.....	.....	.....	.....	.....	10
Zacharias & Son	.....	.....	.....	.....	2	.....	.....	.....	2
Zacharias & Stayman	.....	.....	.....	.....	.....	4	2	.....	6
Fairmount Park & Del. Riv. Pass. Railway Co	.....	.....	.....	10	42	22	.....	.....	74
Zane, H. G	.....	.....	.....	.....	.....	8	.....	.....	8
Coleman, G. Dawson	.....	.....	8	.....	.....	.....	.....	.....	8
Snyder, Geo. & Sons	.....	.....	.....	.....	.....	.....	2	.....	2
	22,228	42,942	46,597	52,652	41,194	44,864	40,015	38,349	328,841

682 *Letters-patent No.* 5112. *Granted Anson Atwood, May 15th,* 1847.
Improvement in cast-iron car wheels.

The schedule referred to in these letters-patent, and making part of the same.

To all to whom these presents shall come:

Be it known that I, Anson Atwood, of Troy, in the county of Rensselaer, and State of New York, have invented a new and useful improvement in cast-iron wheels for railroad carriages, and that the following is a full, clear, and exact description of the principle or character which distinguishes it from all other things before known, and of the manner of making, constructing, and using the same, reference being had to the accompanying drawings, making part of this specification, in which Figure 1 is a perspective representation of a wheel on my improved plan, and Figure 2 a section thereof through the axis. The same letters indicate like parts in all the figures.

The object of my invention is to cast a wheel in one piece, with a solid hub, without subjecting the parts to the liability of breaking; and the nature of my improvement for this purpose consists in connecting the rim with a ring, whose faces are made in radial waves, passing around by a series of curves from one edge of the rim to the other, entirely around, to give a continuous support to the whole width of the rim, and chiefly to yield, without strain on the metal, to the contraction of the ring, which cools after the rim; this mode of connecting the rim and ring being combined with a solid hub by means of a dished
683 flanch or flanches, which admit of yielding to the contraction of the metal in the direction of the radii. In the accompanying drawings *a* represents the rim of the wheel of the usual form, and *b* a ring which is made in a succession of radial waves passing entirely around by a series of curves from one edge to the other of the rim, so that after the rim has been set by the chill, and the ring begins to cool and contract, the waved surface will yield in the direction of the circumference, without producing an injurious strain on the metal.

The inner periphery of this ring is connected with the solid hub *c* by a concave and convex flanch, *d*, the cross sections of which, taken in planes passing through the axis of the hub, will present segments of circles extending from the hub to the waved ring *b*, so as to yield to the contraction in the direction of the radii. This concave and convex flanch, *d*, is, in fact, a continuation of the solid hub, which gradually curves to form the connection with the ring of radial waves. Instead of one concave and convex flanch-like projection or concave ring, *d*, such as above described, there may be two, one for each face of the wheel, as represented in Figure 4. And if desired to afford facility for removing the said core after the wheel has been cast, one or both of the flanches, or concave and convex rings *d*, may be made with radial openings *e*, as shown in Figure 3.

What I claim as my invention, and desire to secure by letters-patent, is, connecting the rim of the wheel, cast in one piece, with a solid hub, by the combination of a ring made of radial waves, in combination with the dished flanch or flanches of the hub, which forms a rim concentric with the rim of the wheel substantially as described, whereby the several parts can yield to the unequal contraction in all directions, without serious strain of the metal as described.

ANSON ATWOOD.

Witnesses:
CH'S M. KELLER.
JORDAN L. MOTT.

684 Whereas I, Nathan Washburne, iron founder, of Worcester, in the county of Worcester, in the Commonwealth of Massachusetts, have invented a certain new and useful improvement in car wheels, consisting in the manner of disposing of the metal in the wheel, and so as to produce great strength and relieve the wheel from strain, for which improvement letters-patent of the United States of America, number 7710, (seventy-seven hundred and ten,) dated the eighth day of October, A. D. 1850, have been granted to me, giving to me and my legal representatives the full and exclusive right of making and vending the said improvement throughout the United States; and whereas George Keck, of the city of Cincinnati, State of Ohio, has this day agreed to purchase from me, through Daniel R. Pratt, my sole agent, the right and license to make, construct, use, and vend for use, as hereinafter licensed, granted, stipulated, car wheels upon the plan and embracing the improvements in the aforesaid patent, at the following places, to wit: the city of Cincinnati, in the State of Ohio, and the cities of Covington and Newport, in the State of Kentucky, and within the territory embraced within two miles from the corporation lines of Covington and Newport, and also within the district limited and defined as follows, to wit: beginning at a point on the Ohio River, one-half the distance between Cincinnati and Portsmouth; thence running back in the State of Ohio on a straight line to London, in Madison County; thence to Springfield, in Clark County; thence to Hamilton, in Butler County; thence to a point on the Ohio River one-half the distance between Madison, in the State of Indiana, and Cincinnati aforesaid; thence up the Ohio River to the place of beginning, including said London, Springfield, and Hamilton, besides all the places and territory included within said boundaries.

685 Whereas said George Keck has paid to me, said Nathan Washburne, by Daniel R. Pratt, my sole agent, the sum of five thousand dollars, the receipt whereof I do hereby acknowledge, through the said Pratt:

Now, therefore, this indenture witnesseth that, for and in consideration of the said sum so paid, I, the said Nathan Washburne, do hereby, under said letters-patent, fully and exclusively license and empower, as aforesaid, the said George Keck, his heirs and assigns, and all persons licensed by and under him or them, with sole and exclusive right and authority, for and during the remainder of the term of fourteen years, for which the said patent is granted, and during the continuance of any renewals or extensions thereof, if any there should be, to make and construct car wheels upon the plan and embracing the principles and improvements of said patent, at the places and within the district aforesaid; and I further license and empower said George Keck, his heirs and assigns, and persons licensed by and under him or them, to use and vend or sell for use car wheels, patented as aforesaid, not only in the district and at the places aforesaid, but also anywhere within the United States.

And, further, to grant to others within the district, and at the places aforesaid, rights and licenses to make and construct car wheels under said patent, and the same to use or vend anywhere within the United States aforesaid.

And it is hereby expressly provided and stipulated that the said George Keck, his heirs and assigns, and all persons licensed by and under him or them, shall make and construct the said car wheels under said patent of good, sufficient, and proper material as to quality, and in a good workmanlike manner, so that the character and reputation of

said wheels under said patent shall not be injured by defective material or workmanship, under a penalty of three thousand dollars.

And I, the said Nathan Washburne, for myself, my heirs, executors, and administrators, hereby covenant with said George Keck, his
686 heirs and assigns, that I have good right under said patent to license and empower him and them as aforesaid, and that I have not given any assignment or license that may or shall interfere or conflict with the rights, privileges, and powers hereby granted and licensed as aforesaid; and further, that I will warrant and defend the said George Keck, his heirs and assigns, against the lawful claims or acts of all persons whatever claiming or to claim under me.

In testimony whereof I, the said Nathan Washburne, by Daniel R. Pratt, my sole attorney, have hereunto set my hand and seal, this seventeenth day of August, in the year eighteen hundred and fifty-three, at the city of Cincinnati, Ohio.

The words "not only in the district and at the places," on the 2d page, between the 23d and twenty-fourth lines, inserted before execution.

NATHAN WASHBURNE, [SEAL.]
By DANIEL R. PRATT,
His Attorney-in-fact.

Witnesses:
EDWIN D. DODD.
E. P. BROOKS, Jr.

STATE OF OHIO, *Hamilton County, ss:*

Be it remembered that, on this the seventeenth day of August, in the year one thousand eight hundred and fifty three, before me, Edwin D. Dodd, a notary public in and for the county aforesaid, came Nathan Washburne, above named, by Daniel R. Pratt, his agent and attorney-in-fact, and acknowledged the execution of the foregoing instrument, to be his voluntary act and deed for the purposes therein named.

Witness my hand and notarial seal, the day and year aforesaid last above written.

[SEAL.] EDWIN D. DODD.

Received and recorded, September 3, 1853.

687 Whereas Nathan Washburne, of the city of Worcester, in the State of Massachusetts, did, on the eighth day of October, A. D. 1850, obtain letters-patent from the United States of America for a certain new and useful improvement in the manufacture of car wheels, consisting in the manner of disposing of the metal so as to produce great strength and relieve the wheel from strain, said letters-patent being numbered (7710) seventy-seven hundred and ten, the exclusive right to manufacture and vend the said patented improvement, being by such letters secured to said Nathan Washburne, his heirs, administrators, or assigns, for the term of fourteen (14) years from the granting of the same; and whereas on the seventeenth day of August, A. D. 1853, by deed of that date duly executed by one Daniel R. Pratt, acting on behalf of, and as the duly authorized agent of said Nathan Washburne, the right or license to make, use, and vend for use the said patented improvement, was, for a consideration in said deed of license mentioned, granted unto George Keck, of the city of Cincinnati, State of Ohio, the extent of the license so granted to said Keck being as follows, as in said deed contained, at the following places, to wit: The

city of Cincinnati, in the State of Ohio, and the cities of Covington and Newport, in the State of Kentucky, and within the territory embraced within two miles from the corporation lines of Covington and Newport; and also within the district limited and defined as follows, to wit: Beginning at a point on the Ohio River, one-half the distance between Cincinnati and Portsmouth, thence running back in the State of Ohio, on a straight line to London, in Madison County; thence to Springfield, in Clark County; thence to Hamilton, in Butler County; thence to a point on the Ohio River, one-half the distance between Madison, in the State of Indiana, and Cincinnati aforesaid; thence up the Ohio River to the place of beginning, including said London,
688 Springfield, and Hamilton, besides all the places and territory included within said boundaries.

The full and exclusive right being by said Washburne, through his said agent and by said deed granted unto said George Keck, his heirs, and assigns, and all persons licensed by and under him or them, for and during the then unexpired term of fourteen years for which said patent was granted, and during the continuance of any renewals or extensions of said patent, if any such there should be, within the district and all the places aforesaid, to make and vend the said improvement so patented to said Washburn. The right being, also, thereby further granted to said Keck to use said improvement in said district, and to use and vend the same anywhere within the United States; with power on the part of said Keck to grant license to others to make said improvement within said district, and the same by them to vend and use anywhere within the United States.

Said deed containing a stipulation on the part of said Keck, that all such car wheels made by him or his assigns under said grant should be made of good material and in workmanlike manner; a penalty for breach of such stipulation being attached in the sum of three thousand dollars (3,000.)

Now, therefore, by reason of the premises, and for a sufficient and valuable consideration to me paid by A. L. Mowry, of the city of Cincinnati aforesaid, I, the said George Keck, do hereby convey, transfer, set over, and assign unto him, the said Albert L. Mowry, his administrators, representatives, and assigns, all the right, title, and interest in said letters-patent to me granted and conveyed by said Washburne, as hereinbefore recited; hereby referring to said deed of license from said Washburne to me, as recorded in the Patent Office, at Washington, D. C., for the full terms and conditions thereof. And I do for myself, my executors, administrators, and assigns, covenant with said
689 Albert L. Mowry, his executors, administrators, and assigns, that I have not given or granted any license inconsistent with the right hereby conveyed; and I do hereby further warrant the interest hereby conveyed unto said Mowry, his representatives and assigns, as against the lawful claims of all persons, claiming by, through, or under me, to be clear, free, and unincumbered.

In testimony whereof I have hereunto subscribed my name and affixed my seal, at Cincinnati, Ohio, on this first day of September, A. D. 1862.

GEORGE KECK. [SEAL.]

Witness:
CHA'S B. COLLIER.
L. S. WORTHINGTON.

STATE OF OHIO, *Hamilton County, ss:*

Personally appeared before the undersigned, a notary public, within and for the county and State aforesaid, George Keck, the grantor in the foregoing instrument, and acknowledged the signing and sealing thereof to be his act and deed for the purposes therein declared.

Witness my hand and seal, this 6th November, A. D. 1862.

{ NOTARIAL SEAL } LEWIS S. WORTHINGTON,
{ HAMILTON COUNTY. } *Notary Public, Hamilton County, Ohio.*

Fee 25 cents, paid by G. Keck.

U. S. PATENT OFFICE.

Received November 10th, and recorded November 17, 1862, in liber S^{6}, page 98, of transfers of patents.

In testimony whereof I have caused the seal of the Patent Office to be hereunto affixed.

[SEAL.] D. P. HOLLAWAY,
Commissioner of Patents.

690 Whereas Anson Atwood, of the city of Troy, State of New York, party of the first part hereto, did obtain letters-patent of the United States of America, for a certain new and useful improvement in cast-iron railroad-car wheels, which letters-patent bear date the 15th day of March, 1847:

And whereas also letters-patent for a portion of the same were reissued on the 9th day of June 1857:

And whereas letters patent for the other portions of the same were reissued on the 22d day of September, 1857:

And whereas said letters-patent were extended on the 27th day of April, 1861, for seven years from the 15th day of May, 1861:

And whereas Albert L. Mowry, of Cincinnati, Ohio, party of the second part, is desirous of acquiring an interest therein for part of the State of Ohio:

Now this indenture witnesseth: That for and in consideration of two thousand dollars, lawful money of the United States of America, the receipt of which is hereby acknowledged, the said party hereto of the first part has assigned, sold, transferred, and set over, and does hereby assign, sell, transfer, and set over, unto the said party hereto of the second part, as far as regards the city of Cincinnati, of the State of Ohio, and a radius of twenty-five miles around the said city, and in so far as the same is concerned only and solely, the said letters-patent and inventions, and the sole and exclusive right therein to manufacture said wheels; and all improvements, extensions, reissues, and renewals, now or hereafter to be made, of said letters-patent, and the exclusive right to make the same in the said city, and radius aforesaid, and the right of selling the same there or in any part of the United States; which right of sale, however, is not exclusive. Subject, however, to two shop licenses issued—one to John Nash, and one to Moore, Richardson & Co.;

691 the same to be held and enjoyed by the said Albert L. Mowry, for his own use and behoof, and for the use and behoof of his legal successors and assigns, to the full extent of the term for which said letters were granted, and of all improvements, extensions, reissues, and renewals thereon and thereof, as fully and entirely in and for the city of Cincinnati and said radius, as the same would have been held by the party of the first part, had this assignment for the said city and radius not been made.

And the said Mowry hereby covenants and agrees that he will in no case trespass upon any other of the territory covered by said letters-patent, either by himself, or by and through agent or their agents, by manufacturing a single machine, or any machine, or right to make machines, except within and for the city and radius aforesaid, but shall have the right to sell the same in any place or places.

And the said party of the first part, for himself, his executors, administrators, and assigns, doth covenant and agree with the said party of the second part, his executors, administrators, and assigns, that he is lawfully seized of a good title in and to all and singular the above patent, and has good and lawful right and authority to sell and assign the same; and that the said party of the second part, and his representatives and assigns, shall, and at all times hereafter may, peaceably and quietly have, hold, use, occupy, possess, and enjoy, the above-granted premises, without let, suit, trouble, molestation, eviction or disturbance of the said party of the first part, his executors, administrators, or assigns, or of any other persons lawfully claiming the same to the extent aforesaid, and that the same now are free, clear, discharged, and unincumbered of and from all former and other grant, titles, charges, estates, judgments, and encumbrances, of what nature or kind soever. Except and also that the party of the first part, and his executors, administrators and assigns, and all persons whomsoever lawfully or equitably claiming any estate, right, title, or interest of, in, or to the
692 herein-granted premises, by, from, under, or in trust for them, shall and will, at any time or times hereinafter, upon the reasonable request, and at the cost of the said party of the second part, his representatives or assigns, make, do, and execute, or cause to be made, done, and executed, all and every such further and other lawful and reasonable acts, conveyances, and assurances in the law for the better vesting and confirming the above-assigned interest to the party of the second part, his representatives or assigns forever, as may be deemed expedient or necessary.

And the said party of the first part, his executors, administrators, representatives, and assigns, the above-described premises unto the said party of the second part, his executors, administrators, and assigns, against the said party of the first part, his executors, administrators, representatives, and assigns, and against all and every person whomsoever lawfully claiming, or to claim the same, shall and will warrant and by these presents forever defend.

In witness whereof, the parties to these presents have hereto interchangeably set their hands and seals this twentieth day of February, one thousand eight hundred and sixty-six.

ANSON ATWOOD. [SEAL.]

Sealed and delivered in the presence of—
JNO. PLATT.
JAMES A. MOORE.

U. S. PATENT OFFICE.

Received June 4 and recorded June 18, 1866, in liber P 8, page 184, of transfers of patents. In testimony whereof, I have caused the seal of the Patent Office to be hereunto affixed.

T. C. THEAKER,
Court of Patents.

693 The United States Patent Office to all persons to whom these presents shall come, greeting:

This is to certify that the annexed is a true copy from the files of this office.

In testimony whereof I, Elisha Foote, Commissioner of Patents, have caused the seal of the Patent Office to be hereunto affixed this seventeenth day of December, in the year of our Lord one thousand eight hundred and sixty-eight, and of the independence of the United States the ninety-third.

[L. S.] ELISHA FOOTE.

In the matter of the application of Asa Whitney for an extension of letters-patent, granted April 25, 1848.

STATE OF PENNSYLVANIA,
City of Philadelphia:

HENRY SNYDER, being duly sworn, doth depose and say that he is now, and has been, in the employ of Asa Whitney as foreman of the foundry, ever since he began to make car wheels in 1847, and that the wheel on which I have written my name and marked A, is a car wheel made by me while in his employ, by casting in the ordinary way, and suffered to cool without the use of Mr. Whitney's patented process.

The wheel marked B, and with my name, was made in precisely the same way, at the same time, and of the same composition of metal, but was cooled by Mr. Whitney's patented process.

The fracture in the spokes of the former wheel was caused by the contraction of the metal after the rim had chilled. The holes bored
694 in the spokes of Exhibit B, was bored after the wheel had cooled, for the purpose of showing that there was no strain on the spokes.

HENRY SNYDER.

Sworn to and signed before me this twenty-second day of March, 1862.

CHARLES E. PANCOAST,
Alderman, Ex-officio Justice of the Peace.

In the matter of the application of Asa Whitney for an extension of letters-patent, granted April 25, 1848.

I certify that the within deposition of Henry Snyder was taken, sealed up, and directed to the Commissioner of Patents by me this 22d day of March, 1862.

CHA'S E. PANCOAST,
Alderman, Ex-officio Justice of the Peace.

Rec'd and filed March 24, 1862.

E. W. W. G.

In the matter of the application of Asa Whitney for an extension of letters-patent, granted to him on the 27th day of April, 1847, for an improvement in casting car wheels.

Argument on behalf of applicant.

This invention consists in taking the car wheel from the mould in

which it is cast, as soon as it can be handled. It is then put into an oven, (constructed so as to heat a number of wheels at one time, and to heat them evenly.) The temperature of the oven is then raised to almost the fusing point, then the oven is tightly closed and suffered to cool slowly. The object is to produce the uniform cooling of the wheels. (For a full description of the process, and the evils which it was intended to, and which it has fully, overcome, see the essay filed at a former day in this case.)

695 1. Is the invention novel? The novelty of the invention, during the whole course of the patent, has never been questioned.

2. Is the invention useful? The wheels made by this process are far superior to any others; they are more durable, running 100,000 miles, or double the distance of other wheels.

The inventor, in his statement, states that he would guarantee them, if properly used, to run this number of miles. J. Dutton Steele, for fifteen years superintendent, engineer, or vice-president of the Reading Railroad Company, testifies that "The statistics of wheels on the Reading Railroad during a period of ten years, shows that the wheels manufactured under the patented process of said Whitney, will run over 100,000 miles, while those manufactured without his process, run about 50,000 miles." John Murphy, a practical car builder in this city, for over twenty-nine years, testifies: "I regard Mr. Whitney's wheel, as manufactured by his patented process, as far superior to any other wheel. His wheels are stronger, and at the same time less liable to break, and will run considerably longer than other wheels. I know of some wheels of Mr. Whitney's, now in use, that have been running for some eight or ten years." The wheel is also much lighter. Mr. Murphy testifying that it is, on the average, ten pounds lighter.

Is the invention valuable and important to the public?

In addition to the value and importance arising from the increased safety and durability of the wheel, there is a great saving to the public from its lightness. The same road can transport an increased amount of freight, equal to the difference between the weight of Whitney's wheels and other wheels. It will be seen by annexed calculation, marked A, that an actual saving of $1,252,636 has been effected on the wheels

696 already manufactured by Whitney, but there are 988,313 wheels in the United States, (see deposition of William Helme,) and the saving, therefore, would be $3,843,076, (vide calculation marked B.) These calculations are made on the assumption that the car wheels run 100,000 mills, as it is clear from the testimony, they do. No money value to the public, however, can be placed upon this wheel, so far as it tends to prevent accidents and loss of life upon railroads.

Has the inventor been adequately remunerated for his time and expense in originating and perfecting it?

To successfully carry out this invention, and to develop it fully, numerous and costly furnaces or chambers were to be erected. These continually required repairs, enlargement, and sometimes alterations, to carry out the process more perfectly. The applicant's account verified by his own oath, and proven by the depositions of William Sellers and Charles Taylor, shows that he has expended $52,970 31.

Selling his wheel for the same price as other manufacturers, he has saved on the 255,640 wheels, made by him, an average of 10 lbs. of metal per wheel, or 2,556,400 lbs., which, at 1½ cents per pound, would be a saving of $38,348.

His account, then, would be:

Expenses	$52,970
Profit or saving	38,346
Deficit	$14,624

Thus, the applicant has failed in being reimbursed, even for the money actually expended by him, and this, when the benefits he has conferred upon the public, amounts to over three million dollars.

697 Has the inventor used due diligence in introducing his invention into general use?

Immediately upon the grant of his patent, he commenced the manufacture of wheels by his process. Rival manufacturers immediately opposed their introduction, by circulating the report that, by the process by which Mr. Whitney's wheels were manufactured, the chilled or outer portion of the wheel would be softened, (vide dep. John Murphy.) Mr. Murphy further testifies: "This was not true, in fact, as I know by long continued use of these wheels, but the industrious circulation of this report, by numerous rival manufacturers, created a prejudice against the wheel which required some years to remove, and which, in fact, with some companies, has been removed only within the last two years. * * * A difficulty which prevented the general introduction of Mr. Whitney's wheel at an earlier date, was that railroad companies could not, without a long comparative trial of his wheels with other wheels, be practically satisfied with the durability of the wheels. He could not, by an exhibition of his wheel, or an inspection of its exterior, demonstrate the advantage due to his mode of manufacture, and it was only by demonstrating on the few roads which he could induce in trying, after the lapse of some years of comparative trial, that they were so far superior to other wheels in strength and durability."

An extension of this patent, is therefore, very respectfully requested.

Very respectfully, your obedient servant,

A. WHITNEY.

PHILADELPHIA, *April* 1, 1862.

698 A.

Number of wheels manufactured by Whitney, 255,640. Saving of 10 lbs. per wheel, 2,556,400 lbs., and as each wheel would run 100,000 miles, it would equal a freight of 255,640,000,000 lbs., carried one mile, or 127,820,000 tons of 2,000 lbs.; this at one cent per ton per mile, would equal	$1,278,200
From this deduct the decreased value of worn-out wheels, owing to the less quantity of metal in them, 255,640 wheels, 10 lbs. less = 2,556,400 lbs. at 1 cent	25,564
Saving	$1,252,636

B.

Number of wheels in the United States, 988,383. Saving of 10 lbs. per wheel = 9,883,830 lbs., and as each wheel would run 100,000 miles, it would equal an increased freight of 988,383,000,000 lbs. for one mile, or 494,191,500 tons, of lbs. 2,000; this at one cent per ton =	$4,941,915 00
From this deduct the decreased value of worn-out wheels, owing to the less quantity of metal in them, 988,383 wheels, 10 lbs. less = 9,883,830 lbs., at 1 cent	98,838 30
	$3,843,073 70

In the matter of the application of Asa Whitney for an extension of letters-patent for improvement in annealing and casting car wheels, granted April 25, 1848.

GEORGE WHITNEY, being duly sworn, doth depose and say:

I am the son of the applicant above named; I know that, prior to the invention above mentioned in the process of making car wheels, my father was in a large locomotive establishment and had very ex-
699 tensive railroad connections and acquaintance; that since obtaining his letters-patent, his entire attention was devoted to the manufacture and introduction of these wheels; the wheels were advertised extensively; specimen wheels were sent gratuitously to any road that desired them for trial. The attempt was also made to induce others to go into the manufacture of them, and for this purpose licenses were granted to a firm in Pittsburgh, and another in Indiana, but these did not give the attention to the subject which it demanded; they made wheels of imperfect character, and were injuring the reputation of the Whitney wheel, after a short trial.

The result of this experience was, that licenses were apt to injure the name of the wheel more than any profit could be gained from them, and it was found to be the only safe course to endeavor to carry on the work under his own direction. Besides sending circulars and advertising these wheels, some competent person has been engaged nearly all the time in making an annual or semi-annual tour throughout the country to extend the sale of these wheels.

I have no interest in the extended letters-patent now applied for by Asa Whitney.

GEORGE WHITNEY.

Sworn and subscribed before me, this fourth day of April, 1862.

CHARLES E. PANCOAST,
Alderman, Ex-officio Justice of the Peace.

In the matter of the application of Asa Whitney, for an extension of letters-patent, granted April 25, 1848.

WILLIAM HELME, being duly sworn, doth depose and say:

I reside in Philadelphia, and have been engaged in locomotive building, and have been for many years familiar with railroad matters. For
700 several months past, I have been traveling over the principal roads west; I have prepared an abstract from the statement contained in the American Railroad Journal, showing the number of miles of railroad in use in the United States, and the amount of rolling stock at present in use, making an agregate of 998,383 wheels. This calculation was made from the American Railroad Journal, which is considered among railroad men as reliable authority; the statement therein contained, being made out every year from official returns from the several companies. The rolling stock is given for most of the roads; where it is not given, I filled the omission by taking the average per mile of rolling stock on all the roads, whose rolling stock was given. In one case I supplied the omission from my own direct knowledge, that of the Bellefonte and Snow Shoe Railroad Company.

The statement used by me, is found on pages 193 to 196, inclusive, of the American Railroad Journal, filed by me, with this deposition.

WILLIAM HELME.

Sworn and subscribed before me, this 22d day of March, A. D. 1862.

JAMES McCAHAN,
Alderman and J. P.

701 *A statement showing the number of railroads in operation in the United States, and the length of each, with the number of engines and cars in use, taken from the "American Railroad Journal" of March 15th, 1862.*

Names of companies.	Miles of main lines.	Miles of branch lines.	No. of engines.	No. of passenger cars.	No. of freight cars.
Alabama and Florida	65.0				
Alabama and Mississippi	30.3	.....	2	2	19
Alabama and Tennessee Rivers	109.6	.....	11	9	102
Mobile and Girard	57.0				
Mobile and Ohio	469.3	13.5	40	28	502
Montgomery and West Point	88.5	28.4	23	14	283
Memphis and Little Rock	38.5				
Sacramento Valley	22.5				
Danbury and Norwalk	23.8	.....	4	4	43
Hartford, Provid. and Fishkill	122.4	.....	16	20	241
Housatonic	74.0	.....	11	11	240
Naugatuck	57.0	.....	11	7	179
N. Haven, N. Lond. & Stoningt'n	62.0	.....	6	12	29
New Haven and Northampton	46.0	8.8			
New London and Northern	66.0	.....	7	7	111
New York and New Haven	61.3	1.0	31	74	368
Norwich and Worcester	66.0	.....	14	17	282
Delaware	84.3				
New Castle and Frenchtown	16.2				
Florida Road	154.2				
Florida and Alabama	32.0	.....	3	1	6
Florida, Atlantic and Gulf Cent	59.9				
Pensacola and Georgia	100.0	3.9			
Atlanta and West Point	86.7	.....	16	7	194
Atlantic and Gulf Main Line	92.6				
Augusta and Savannah	53.0				
Brunswick and Florida	43.5				
Cent. Georgia R. R. & Bank'g Co	191.0	.....	53	62	697
Georgia Railroad and Bank'g Co	171.0	61.0			
Macon and Western	102.5	.....	19	16	171
Muscogee	50.0	.....	7	2	107

A statement showing the number of railroads, &c.—Continued,

Names of companies.	Miles of main lines.	Miles of branch lines.	No. of engines.	No. of passenger cars.	No. of freight cars.
702 Savannah, Albany and Gulf	68.1	.....	3	4	33
South Western	106.1	100.8	18	22	201
Western and Atlantic	138.0	.....	32	24	705
Chicago, Alton and St. Louis	220.0	.....	38	36	647
Chicago, Burlington and Quincy	138.0	.....	62	31	990
Chicago and Milwaukee	45.0	.....	6	14	101
Chicago and North Western	194.0				
Chicago and Rock Island	181.8	.....	58	57	960
Fox River Valley	33.2				
Galena and Chicago Union	121.0	138.5	60	63	1,369
Great Western, (Ill.)	175.0				
Illinois Central	252.0	.....	113	96	2,305
Ohio and Mississippi	148.0				
Peoria and Bureau Valley	46.6				
Peoria and Oquawka	186.0				
Quincy and Chicago	100.0				
Rock Island Bridge	1.0				
Terre Haute, Alton and St. Louis	168.5	39.8	31	30	424
Cincinnati and Chicago	108.0				
Cincinnati, Peru and Chicago	29.0				
Evansville and Crawfordsville	109.0				
Indiana Central	72.4	.....	19	15	374
Indianapolis and Cincinnati	98.8	20.2	23	19	313
Indiana, Pittsburgh and Cleveland	84.0				
Jeffersonville	78.0	.....	15	16	119
La Fayette and Indianapolis	64.0				
Madison and Indianapolis	86.0	49.0	23		
Louisville, New Albany and Chi	288.0				
Peru and Indianapolis	74.0				
Terre Haute and Richmond	73.0	.....	18	25	298
Burlington and Missouri	75.5				
Chicago, Iowa and Nebraska	86.0				
Dubuque and Pacific	50.1	.....	8	8	86
Keok., F't Des Moines and Minn	38.5	.....	4	4	64
Keok., M't Pleasant and Musc	11.2				
Mississippi and Missouri	55.0	52.6			
Covington and Lexington	80.0				
Lexington and Big Sandy	20.0				
Lexington and Danville	13.0				
Lexington, Frankfort and Louisv	94.1	.....	13	10	230
Louisville and Nashville	185.0	84.0	30	20	455
Maysville and Lexington	18.8				
Clinton and Port Hudson	22.0				
Mexican Gulf	27.0				
703 N. O., Opelousas and Gt. Western	80.0	.....	12	12	216
N. O., Jackson and Gt. Northern	206.0	.....	45	37	513
Vicksburg, Shreveport & Texas	53.7				
Androscoggin	36.5	.....	4	4	21
Androscoggin and Kennebec	55.0	.....	9	10	128
Atlantic and St. Lawrence	149.0	.....	41	17	349
Bangor, Oldtown, and Milford	12.5	.....	4	3	45
Kennebec and Portland	63.0	9.5	12	11	120
Penobscot and Kennebec	54.7	.....	4	10	93
Portland, Saco and Portsmouth	51.3	.....	11	13	118
Somerset and Kennebec	37.0				
York and Cumberland	18.5				
Baltimore and Ohio	279.6	7.2	235	124	3,272
Washington Branch	30.0	.....	7	33	167
Northern Central	138.0	4.0	41	31	1,723
Berkshire, (Mass.)	21.2	.....	6	4	80
Boston and Lowell	26.8	1.8	21	26	566
Boston and Maine	74.3	8.8	32	54	606
Boston and Providence	47.0	7.0	22	27	210
Boston and Worcester	44.6	24.0	30	59	295
Cape Cod Branch	46.1	1.1	7	10	109
Connecticut River	50.0	2.4	12	13	331
Eastern	44.1	30.5	28	47	429
Essex	19.9	1.3			
Fitchburg	50.9	16.8	29	28	655
Fitchburg and Worcester	14.0	2.4	3	3	37
Hampshire and Hampden	24.9				
Lowell and Lawrence	12.4	.....	2	3	27
Nashua and Lowell	14.6	.....	12	12	324
New Bedford and Taunton	20.2	1.6	7	16	146
Newburyport	26.9	.....	5	9	44
New York and Boston Air Line	8.6				
Old Colony and Fall River	79.5	7.8	27	46	358

A statement showing the number of railroads, &c.—Continued.

Names of companies.	Miles of main lines.	Miles of branch lines.	No. of engines.	No. of passenger cars.	No. of freight cars.
Pittsfield and N. Adams	18.6	.....	1	2	1
Providence and Worcester	43.4	1.0	12	18	308
Salem and Lowell	16.9	.....	3	3	1
South Shore	11.5	.....	2	7	17
Stockbridge and Pittsfield	21.9				
Taunton Branch	11.1	0.6	7	18	144
Troy and Greenfield	6.1				
Vermont and Massachusetts	69.0	8.0	11	18	192
Western, (incl. Alb. & W. S. &c.)	156.1	17.3	72	59	1,183
Worcester and Nashua	45.7	.....	10	18	149
Bay De Noquet and Marquette	17.3	.....	2	1	100
704 Chicago, Det. & Can. G. T. Junct.	57.0				
Detroit and Milwaukee	188.0				
Michigan Central	284.8	.....	98	85	1,334
Michigan Southern and N. Inda.	246.0	293.0	83	102	971
Miss. Central	236.0	.....	25	22	336
Miss. and Tennessee	71.4	.....	7	4	41
Southern Miss	83.2				
Cairo and Fulton	37.0				
Hannibal and St. Joseph	206.8				
North Missouri	168.8	.....	22	19	391
Pacific	189.0	.....	28	26	375
South Western Branch Mo	77.0				
St. Louis and Iron Mountain	86.5	3.6	16	13	222
Ashuelot	23.1				
Boston, Concord and Montreal	93.5	.....	14	10	232
Cheshire	53.6	.....	18	11	289
Cocheco	28.1	.....	4	4	26
Concord	34.5	.....	21	22	494
Concord and Portsmouth	46.8				
Contoocook River	14.6				
Eastern, (New Hampshire)	16.5				
Great Falls and Conway	20.5	.....	3	2	27
Manchester and Lawrence	26.8				
Merrimack and Con. Rivers	57.7	.....	2	4	80
Northern New Hampshire	69.2	12.8	22	13	372
Sullivan	24.7	.....	5	2	50
Belvidere and Delaware	64.2				
Camden and Amboy	63.9	32.3			
Camden and Atlantic	60.2				
Central of New Jersey	64.0	.....	30	21	256
Long Dock	2.9				
Morris and Essex	53.0	.....	11	15	91
New Jersey	33.8				
Northern New Jersey	21.3	.....	2	6	17
Patterson and Hudson	13.5				
Patterson and Ramapo	15.0				
Warren	18.7				
West Jersey	13.0				
Albany and Susquehanna	00.0				
Albany and Vermont	32.9	.....	5	12	53
Albany and West Stockbridge	38.3				
Black River and Utica	34.9	.....	4	6	39
Blossburg and Corning	14.8				
Brooklyn Central and Jamaica	14.5	.....	.....	28	
705 Brooklyn City	24.7	.....	.....	158	
Buffalo, New York and Erie	142.0	.....	28	32	402
Buffalo and State Line	68.3	.....	28	34	327
Cayuga and Susquehanna	34.6				
Chemung	17.4				
Elmira, Jefferson and Canada	46.8	.....	10	8	83
Hudson and Boston	17.3				
Hudson River	144.0	.....	58	107	554
Long Island	84.0	2.5	17	40	196
New York Central	297.8	258.1	211	237	3,171
New York and Erie	446.0	19.0	219	194	2,763
New York and Harlem	138.0	2.1	33	93	576
New York and Flushing	8.0	.....	2	8	8
Niagara Bridge and Canada	99.0				
Northern (Ogdensburg)	118.0	3.8	28	14	578
Oswego and Syracuse	35.9	.....	7	6	46
Pottsdam and Watertown	75.4	.....	6	4	33
Rensselaer and Saratoga	25.2	.....	5	13	70
Rochester and Genesee Valley	18.5				
Sackett's Harbor and Rome, N. Y.	18.0				
Saratoga and Schenectady	21.0	.....	2	2	

A statement showing the number of railroads, &c.—Continued.

Names of companies.	Miles of main lines.	Miles of branch lines.	No. of engines.	No. of passenger cars.	No. of freight cars.
Saratoga and Whitehall	40.8	6.7	9	11	84
Staten Island	13.0	.....	2	6	6
Syracuse and Binghampton	81.3	.....	13	12	117
Troy and Boston	31.9	.....	10	9	123
Troy and Greenbush	6.0				
Troy and Union	2.1				
Watertown and Rome	96.7	.....	17	11	288
Atlantic and North Carolina	94.9				
North Carolina	223.0				
Raleigh and Gaston	97.0				
Wilmington and Manchester	161.5	15.0	23	18	182
Wilmington and Weldon	161.9	.....	24	32	144
Western North Carolina	81.0	3.0			
Atlantic and Great Western					
Bellefontaine and Indiana	118.2	.....	17	12	208
Central Ohio	137.0	.....	41	39	508
Cincinnati, Hamilton and Dayton	60.3	.....	22	28	432
Cincinnati and Indianapolis Junc	30.0				
Cin., Wilmington and Zanesville	131.8	.....	16	10	332
Cleveland, Col. and Cincinnati	135.4	5.8	22	31	495
Cleveland and Mahoning	67.0	.....	12	11	251
Cleveland, Paynesville and Astal	95.4	1.2	30	42	470
Cleveland and Pittsburgh	101.0	102.5	42		
706 Cleveland and Toledo	109.2	79.4	32	45	409
Cleveland, Zanesvile and Cin	61.4	.....	5	6	99
Columbus and Indianapolis	72.0	.....	6	9	103
Columbus and Xenia	54.5				
Dayton and Michigan	144.0				
Dayton, Xenia and Belpre	16.0	.....	3	2	21
Eaton and Hamilton	45.0	.....	6	5	72
Fremont and Indiana	36.0				
Greenville and Miami	32.0	.....	6	5	68
Iron	13.0	.....	1	2	50
Little Miami	83.5	.....	39	32	602
Marietta and Cincinnati	173.8	21.6	33	26	523
Ohio and Mississippi	192.3	.....	48	34	628
Pittsburgh, Columbus and Cin	117.0	8.0	17	16	238
Sandusky, Dayton and Cin	153.9	52.0	40	26	391
Sandusky, Mansfield and Newark	116.0	9.0	13	20	206
Scioto and Hocking Valley	55.6	.....	7	3	64
Springfield and Columbus	19.5				
Springfield, Mt. Vern. and Pittsb	49.8	.....	5	6	62
Tol do, Wabash and Western	243.0	.....	35	18	580
Allegheny Valley	45.0	.....	4	6	97
Beaver Meadow	20.5	.....	15	2	1,005
Catawissa	64.5	.....	22	14	300
Cumberland Valley	52.5	.....	11	8	66
Del., Lackawanna and Western	110.8	2.3	74	17	4,422
East Pennsylvania	36.3	.....	3	3	
Erie and Northeast	18.6				
Harrisburg and Lancaster	36.9	18.6			
Hempfield	32.3	.....	3	2	17
Huntingdon and Broad Top	30.9	11.3	6	3	1,000
Lackawanna and Bloomsburg	68.9	.....	10	6	318
Lehigh Valley	45.7	.....	15	6	
Little Schuylkill	28.0	5.0	9		
Lehigh Coal and Navigation Co	20.0				
Mine Hill and Schuylkill Haven	24.5	74.8	28	2	3,026
North Pennsylvania	55.6	10.1	17	20	504
Pennsylvania Central	331.1	28.1	205	124	2,668
Phil'a and Baltimore Central	12.0	.....	1	1	1
Phil'a, Germant'n and Norristown	17.0	7.0	16		
Philadelphia and Reading	147.4	4.0	145	64	5,696
Philadelphia and Trenton	28.0				
Phil'a, Wilmington and Baltimore	98.0	6.0	30	93	521
Pittsburgh and Connellsville	48.9	.....	7	7	65
Pittsburgh, Ft. Wayne & Chicago	467.5	.....	104	80	1,261
707 Pittsburgh and Steubenville	31.0				
Schuylkill and Susquehanna	54.0	.....	7	7	26
Schuylkill Valley	9.2	15.3			
Shamokin Valley and Pottsville	28.0	1.2	4	1	445
Sunbury and Erie	148.0				
Tioga	29.6	6.5	8	3	127
West Chester and Philadelphia	26.4	.....	4	11	9
Williamsport and Elmira	78.0	.....	16	8	125
Bellefonte and Snow Shoe	24.0	.....	1	1	75
N. Y., Providence and Boston	50.0	.....	12	17	103

A statement showing the number of railroads, &c.—Continued.

Names of companies.	Miles of main lines.	Miles of branch lines.	No. of engines.	No. of passenger cars.	No. of freight cars.
Providence, Warren and Bristol	13.6	.....	.....	3	5
Blue Ridge	13.2	1.5	2	.....	26
Charlestown and Savannah	54.9	.....	4	3	21
Charlotte and South Carolina	109.6	.....	13	9	176
Cheraw and Darlington	40.3				
Greenville and Columbus	143.3	21.2			
Kings Mountain	22.5				
Laurens	32.0				
North Eastern	102.0				
South Carolina	136.0	106.0	62	59	790
Spartansburg and Union	25.1				
Central Southern	47.6				
East Tennessee and Georgia	30.0	.....	12	10	171
East Tennessee and Virginia	140.0	.....	10	10	128
Memphis and Charleston	271.6	19.4	43	39	667
Memphis and Ohio	271.6	16.0	9	5	242
Memp., Clarksv'le and Louisv'le	100.0				
Mississippi and Tennessee	59.0	.....	7	5	119
Mississippi Central and Tennessee	47.4	.....	4	5	46
McMinnville and Manchester	34.2	.....	12	2	81
Nashville and Chat'anooga	149.7	44.0	39	17	319
Tennessee and Alabama	45.8	.....	5	5	29
Winchester and Alabama	30.0				
Buffalo, Bayou Braz. and Colorado	32.0				
Galv'ton, Houston and Henderson	56.0				
Houston and Brazoria	50.0	.....	2	1	40
Houston Texas Central	70.0	.....	7	5	124
San Antonia and Mexican Gulf	25.0				
Southern Pacific	28.0				
Connecticut and Passumpsic	90.7	.....	8	8	183
Rutland and Burlington	119.6	.....	26	18	600
Rutland and Washington	62.0	.....	10	6	174
Vermont Central	119.0	.....	42	28	885
Vermont and Canada	47.0				
708 Vermont Valley	23.7	.....	3	4	43
Western Vermont	54.0	10.5			
Alex., Loudon and Hampshire	41.3				
Manassas Gap	77.8	8.9	9	5	221
Norfolk and Petersburg	79.2	.....	5	2	75
North Western Virginia	103.5	.....	8		
Orange and Alexandria	88.3	68.4	16	16	175
Petersburg and Lynchburg	123.3	10.1	19	13	279
Petersburg and Roanoke	59.2	21.3	14	17	131
Richmond and Danville	140.5	2.7	28	30	418
Rich'd, Fredericksb'g, and Potomac	75.1	.....	11	10	196
Richmond and Petersburg	22.2	2.8	10	7	188
Richmond and York River	23.7	.....	2	.....	23
Seaboard and Roanoke	80.0	.....	10	11	161
Virginia Central	178.2	.....	27	19	228
Virginia and Tennessee	204.7	9.4	39	27	374
Winchester and Potomac	32.0	.....	5	4	49
Kenosha and Rockford	55.0	.....	3	2	40
Milwaukee and Minnesota	199.9				
Milwaukee and Chicago	40.0	.....	5	10	75
Milwaukee and Horicon	42.0				
Milwaukee and Prairie du Chien	191.9	42.5			
Milw kee, Watert'n and Baraboo	50.0				
Racine Mississippi	104.0	.....	8	7	321
Wisconsin Central	10.0				
Totals	24,368.0	2,260.9	4,742	4,424	80,801

709 Total number of miles of finished railroad in use in the United States, as reported to the "American Railroad Journal" 26,628.9

Number of miles of the above, for which neither cars or engines are reported 7,531.9

Number of miles reported, with cars and engines ..... 19,097.

Cars and engines reported as being operated on the above	89,967
Average number of wheels to each	8
Total number of wheels	719,736

If the 7,531 miles of road reported without the cars and engines, is similarly stocked to the above, they would have 278,647 wheels in use, which, added to the above number, would make a total of 993,383 wheels as being in use throughout the United States on the various railroads comprised in the above report.

In the matter of the application of Asa Whitney, for the extension of patent for improvement in annealing and cooling cast-iron car wheels, granted to him the 25th day of April, A. D. 1848, for the additional term of seven years from and after the day whereon said patent will expire.

SIR: I have the honor to submit, in the above case, the following report:

1st. That the invention claimed in the said patent was new at the period of its date.

2d. That it is useful.

3d. That it is valuable and important to the public, particularly to those holding pecuniary interests in railroads, or who are in any wise interested in the rates of transportation charged by railroad companies.

710 4th. The statement of the applicant, to the truth of which he has made oath, shows that he commenced the manufacture of car wheels, by his new process, in the year 1847. Satisfied as he was, by practice, of the soundness of the theory upon which his improvement was based, he soon found by experience also, that his annealing chambers were defective in several important particulars, which induced him, in 1849, to construct a new set of chambers, together with other necessary adjuncts and appurtenances. These new chambers were better than those previously in use, but still were not satisfactory; they were continued in use, however, until 1853, when in view, partly of the increased demand for the wheels, and the increased facility required for their manufacture, as well as the defects existing in his present works, it was resolved to remove to a different locality, and to erect an entirely new manufactory.

Each renewed construction of annealing chambers were found to be superior to and more satisfactory than the preceding ones; the third set, however, were still liable to some objections; and not being satisfied to rest short of the fullest and most perfect development of his invention, the applicant again, in 1857, removed the chambers then in use, and erected others, a fourth set, improved in construction, as well as of greater capacity.

These chambers have operated to the entire satisfaction of the applicant; no attempt has been made to improve thereon, nor does the applicant now see in what manner they can be improved.

In his statement of the cost of these several improvements, the applicant has included the cost, not only of the annealing chambers themselves, but also the fixtures necessarily connected therewith; as, for instance, the chimney-stack, hoisting cranes for removing the heated wheels to and from the chambers, together with 10 per cent. of the entire cost of the buildings and ground used for the purpose.

711 From the detailed statement, it appears that the total expense of the applicant in developing his invention, was as follows:

First set of chambers, including, also, the expense incurred for procuring patent	$2,344 37
Second set of chambers, with crane, and 10 per cent. of cost of buildings and ground	7,679 77
Third set of chambers, with chimney stack, crane, &c	9,929 73
Fourth set of chambers, with two hydraulic cranes, force-pumps, &c	28,200 96
To which is added 10 per cent. for superintendent, &c	4,815 48
Total expenditures	$52,970 31

In the statement of the profits derived thus far from his invention, the applicant premises by saying, in substance, that other things being equal, there is no difference in the cost per pound of his wheels, and those made by others in the ordinary mode of casting, but that his process of annealing enables him to produce as good a wheel as others, with a less weight of metal, and that in the saving of iron thus effected, equal, on an average, to about 10 lbs. for each wheel, consists the advantage resulting from his patent over his competitors in business.

The total number of wheels manufactured under his patent, up to the 1st January, 1862, is stated at 255,640; allowing for a saving of 10 lbs. of iron for each wheel, and the value of pig iron assumed to be 1½ c. per lb., which is probably a reasonable estimate, the profits accruing to the applicant from his invention may be stated thus:

255,640 wheels, at 10 lbs. each, 2,556,400 lbs., at 1½ c	$38,346 00
Excess of expenses over and above profits	14,624 31

712 From an economical point of view, as regards the public, the applicant exhibits a statement, wherein any *success* in the weight of the rolling stock of a railroad is likened to and assumed to be, in fact, to that extent, *and* excess of freight carried over the road; or, conversely, that by reducing the weight of the rolling stock, its strength and efficiency otherwise not being impaired thereby, below the average standard of other rolling stock in use, and allowing each wheel to traverse 50,000 miles of rail before being worn out, the saving effected by those using his 255,640 wheels, is equivalent to 63,910,000 tons carried one mile, and which, at 1 cent per ton per mile, equals $639,100. The value of the old wheels, however, will be less than that of an equal number of worn-out wheels of other manufacturers, by the difference in their weight, viz, 10 lbs. for each wheel, or, in the aggregate, less by 200,536,400 lbs. Assuming, therefore, the value of the worn-out wheels to be 1 cent per lb., the difference in the value between the 255,640 wheels of his manufacture and an equal number of those of other manufacturers, will be equal to a sum of $25,564. Deducting this amount from the $639,100, and there thus results a saving to the public a sum equal to $613,536, or $2 40 for each wheel.

If we assume the premises of the applicant to be correct, viz, that a wheel manufactured by his process will wear as long and do as much service as that made in the ordinary way, which shall weigh 10 lbs. more than his, the above deduction as to the pecuniary saving effected by the use of his wheels *are* undoubtedly fair and legitimate. But the applicant further avers that, while, in his opinion, the average wear of wheels made by other manufacturers does not exceed 50,000 miles, he

is enabled, by statistics in his possession, to state that the durability of his wheels actually exceed 100,000 miles, and that, with fair usage, he does not hesitate to guarantee that amount of service.

The superior durability is accounted for by saying that, by the use of his improved process of annealing, the wheels may be made of iron of a higher temper, and becoming thereby more deeply chilled, they will necessarily wear longer.

713 It is also in evidence that, owing to defects in the first, second, and third sets of annealing chambers, it not unfrequently happened that some of the wheels would, in the process of annealing, be more or less injured, owing to the impossibility of insuring to each wheel in the chamber an equal degree of heat; that while some of them would be insufficiently heated, others would be heated to excess, so as to destroy partially or wholly the crystalline texture, the necessary condition of its hardness, which has been produced in the tread of the wheel, by the action of the chill into which the metal had been cast.

Some of the wheels of this latter character, by inadvertence, passing inspection, applied to use and resulting, as might have been anticipated, in failure, gave seemingly a warrant to his competitors i n business, for condemning, not only the wheels themselves, but also theprocess adopted in their manufacture. These unfortunate circumstan es and the arguments based upon them, were extensively used by his competitors, and greatly to the inconvenience and loss of the applican during more than one-half the term for which his patent had been gra ted.

Another circumstance, which contributed in a similar manner and to a considerable extent in weakening the confidence of the public and thus injuriously affecting the business of the applicant, was the unfortunate and perhaps injudicious use of the word "annealing" in the denomination of his invention. The meaning usually and properly attached to this word is that of softening and making malleable. The idea, therefore, of retaining the hardness induced by the chill into the tread by subsequent annealing, seemed opposed to common experience and contrary to fact.

However reasonable this argument may appear in its application to the then known and practised modes of annealing cast iron, it is not believed to be valid against the improved process practised by the

714 applicant, provided only, that certain conditions be maintained and proper care be observed in conducting the process.

It is also observed that of the 255,640 wheels manufactured by the applicant, under his patent, 157,690, or 62 per cent. of the whole, were produced during the six years ending January 1, 1862. Granting, as we should, that the consumption of car wheels has been greater during this period than any corresponding period of previous time, there still remains a reasonable supposition that the great improvement effected in the construction of the chambers, and the gradual disabusing the public mind as to the effect of the annealing process, as practised by the applicant upon the chilled tread of his cast-iron wheels, contributed, in no small degree, to the increased demand for wheels thus made.

To briefly recapitulate, the applicant, it appears, has expended, in the development of his invention, the sum of	$52,970 31
Amount received by him as profits	38,346 00
Excess of expenditure over profits	$14,624 31

For so large an outlay of capital, and the annoyance and inconven-

ience attending the several reconstructions of his works, as well as the mental labor involved, the profits, as above stated, do not seem to be an adequate remuneration.

5th. It does not seem, from the evidence, that any special effort has been made by the applicant to introduce his invention into general use, otherwise than by the introduction of the wheels of his own manufacture, nor that the invention is practised by any other party than himself.

It is not unreasonable to suppose that the strong doubt which, until recently, has prevailed as to the value of the invention, and the large expenditure of capital which would be required to render the in-
715 vention available, may have rendered any effort to effect its general or even partial introduction, otherwise than as stated—abortive.

Respectfully, yours,

J. W. JAYNE,
First Assistant Engineer.

Hon. D. P. HOLLOWAY,
Commissioner.

PATENT OFFICE, *March* 17, 1862.

U. S. PATENT OFFICE,
April 7, 1862.

The within report is approved and confirmed, and the patent is ordered to be extended.

D. P. HOLLOWAY,
Commissioner.

Recorded vol. 9, p. 166.

In the matter of the application of Asa Whitney for an extension of letters-patent, granted April 25th, 1848.

Statement of Asa Whitney.

Prior to my patent for annealing or prolonging the cooling of cast-iron car wheels, I had experimented in a comparatively small way, as to the best means to be employed to accomplish the object desired.

Copies of the drawings of the first furnaces or chambers used for that purpose are attached to the patent. The trials made in the manner described in the schedule attached to the patent were satisfactory, so far as the soundness of the theory upon which the improvement rested was concerned, but practically it was shown that the furnaces or chambers were defective, rendering great care necessary in their
716 attendance. There was found to be too much heat applied to the two or three lower wheels in the pile, and not enough to the top ones; those at and near the bottom were exposed to a temperature so high, or so near the point of fusion, as to destroy or impair the chill, and the temperature of those at and near the top was not raised high enough to relieve them from the strain acquired, while the object desired was accomplished on the residue of the pile, those wheels being relieved from all inherent strain, and the chill not being injuriously effected by the heat they had been exposed to.

Having thus satisfied myself as to the soundness of the theory upon which the value of the improvement was based, it remained to be determined what was the best practical means to be employed for accomplishing the object.

In the spring of 1847, in company with my son George, we hired a small foundry in this city, in which, early in the following June, we

commenced to prepare for casting and treating wheels in the manner described in the schedule attached to the patent referred to. There were three of these annealing chambers erected; the wheels remained in each of them three days; consequently only one could be emptied and refilled daily.

We continued to use them, however, without material alteration, until September, 1849; they were not only defective in the particulars before noted, but they lacked capacity for more than twelve wheels per day, while the demand for them began to exceed that number.

In August, 1849, we began to prepare for remedying the defects alluded to—want of uniformity of effect on the wheels treated, and want of capacity. There was not room enough in the foundry we were occupying to make the changes, without lengthening the building. It also became necessary to erect another chimney and crane, as well as to make several other alterations in the building and its appendages to adapt them to the increased number of wheels we contemplated
717 making daily. This work was completed so far as to enable us to commence using it, in September, 1849. The changes made gave us the capacity to make and anneal 48 wheels per day, and with proper attention, we had much less difficulty in applying and controlling the heat generated, more uniformly to all the wheels in this second set of annealing chambers than in the first.

The demand for our wheels continued to increase, so that during the next year, 1850, our sales began to be limited again by our capacity to make. The place we were occupying not being susceptible of further economical enlargement, we began to canvass the matter of erecting new works, specially adapted to casting and treating car wheels in the manner we had thus far developed. With us, there was no longer any doubt but that cast-iron wheels, made and treated in this way, were safer and more durable than those made and treated in any other way, besides being a little lighter than any others; hence we decided to prepare improved facilities for making them in a much larger way than we had heretofore done.

In March, 1851, we commenced building entire new works on a lot previously purchased, 200 by 400. The designed capacity of these works was 150 wheels per day, leaving room on the lot and otherwise so arranged, as to admit of further enlargement, should the demand require it. No pains or expense were spared to make these works as perfect and as well adapted to the manufacture and fitting up car wheels, as our previous experience enabled us to employ in designing and erecting them.

Early in May, 1853, the new works were so far completed as to enable us to commence operations on them. The increased capacity they furnished was more than was required, until 1855; the greatly increased demand of that year began in October and continued through 1856, to the fall of 1857, the orders being larger, in several instances, than
718 we could execute within the time desired; this induced us to carry out our original design of providing for making at least 200 wheels per day.

The buildings for this increased capacity were commenced early in 1856, and completed during that year. Notwithstanding the third set of annealing chambers (completed in 1853) answered the purpose intended satisfactorily, so far as the treatment of the wheels was concerned, yet they were found to be more expensive to maintain, and not as convenient to attend, as we believed others could be made, on a somewhat different plan and arrangement. We therefore removed them,

and erected in their stead a fourth set, having the increased capacity desired, which we have since found to be a very decided improvement upon their predecessors. This fourth set of annealing chambers was not completed until the fall of 1857, and with them we erected hydraulic cranes, which have added very much to the facility and economy in depositing wheels in, and taking them out of, the annealing chambers; considerable alterations and improvements have been made in these cranes since their first erection, and they are now worked satisfactorily.

No improvement has been made or attempted on the fourth set of annealing chambers since their completion in 1857, nor do we now see in what respect they can be improved.

The accompanying statement, marked A, will show the cost in detail, under each head of expenditure, in bringing this annealing process to its present state of perfection.

The accompanying tracings, marked 1, 2, 3, 4, are taken from the original drawings of each of the four sets of annealing chambers, numbered in the order in which they were constructed. These tracings, with the preceding remarks, will sufficiently explain the progressive improvement in those structures.

719 The following statement shows the number of wheels made by us each year, commencing in 1847, up to January 1, 1862, all of which have been subjected to the process of annealing or protracted cooling:

1847, made	480	wheels.
1848, "	3,033	"
1849, "	6,852	"
1850, "	10,881	"
1851, "	12,965	"
1852, "	14,463	"
1853, "	15,027	"
1854, "	17,107	"
1855, "	17,142	"
1856, "	33,562	"
1857, "	30,903	"
1858, "	14,764	"
1859, "	24,834	"
1860, "	32,934	"
1861, "	20,693	"
Total	255,640	"

It will be observed that the most considerable interruptions to a tolerably uniform annual increase of the number made occurred in 1857 and 1861. These checks to a more uniform, continual growth, are attributed mainly to the same causes that have effected similarly about all other industrial branches of business at and during the terms alluded to, the financial crisis commencing in the fall of 1857, and the rebellion in 1861.

Besides these, there was another cause more potent than all others to retard the demand for our wheels; it was this: We
720 claimed that the process of annealing, or more properly, protracted cooling, to which we subjected our wheels, imparted to them more strength, rendering them safer, while at the same time they were lighter than those made in any other way. This was not denied, but as the popular definition of anneal was to soften, it was more or

less successfully urged by our competitors that the annealing process would so soften the chilled tread as to very much lessen the durability. This theory had just enough truth in it to render it difficult to prove false, so far as it applied to our wheels when properly treated. It is true the chill may be impaired or entirely destroyed by raising the temperature in the annealing chambers too high; this occurred more frequently while we used the first set of annealing chambers than subsequently, although it occasionally happened in the use of the second set; less frequently in the third; never in the fourth set, now in use. Some of the first of these overheated wheels, that escaped detection by the inspection they were subjected to, were put in use; they, of course, performed very little service; the fact, however, that they were so injured by the annealing process, was extensively used by our competitors as a confirmation of the truth of their prediction in the premises, until more than half the term for which the patent was granted had expired, and we had expended more than $50,000 in erecting successively, improved structures to accomplish the object aimed at—for a more elaborate exposition of the history of chilling and annealing car wheels (as practised by us) than seems to belong to this statement.

PROFITS.

I believe there is no essential difference in the cost per pound of making cast-iron chilled car wheels, of the various patterns and by the different modes in use, providing the same skill and system control the manufacture. But by my process I am enabled to make them
721 lighter than those made in any other way for a similar service, and I can therefore afford to sell them at the same price per wheel as other makers, and save the cost of the difference in weight. This saving of metal, therefore, I deem to measure the essential advantage I have over my competitors, and also the profits arising from my patent.

There have been made to January 1, 1862, under my patent, 255,640 wheels of all sizes. From the best data I have been able to get upon the subject, I estimate that 10 lbs. per wheel would be a fair average of the metal saved by my process. On the large sizes there is greater difference than this, but on the small sizes less. I therefore deem 10 lbs. per wheel as an average difference of weight between my wheels and those of other makers. The total amount of metal saved in all the wheels made, as before stated, to January 1, 1862, would therefore be 2,556,400 lbs., and the cost of the same, at the average price paid for pig iron, say 1½ cents per lb., amounts to $38,346, while to develop and perfect my annealing process has cost, as per statement marked A, $52,970 31.

The fourth set of annealing chambers, erected in 1857, were the first that have, in all respects, answered the purpose for which they were constructed, although the third set were a decided improvement on their predecessors, and the character of our wheels had been so much improved thereby that the demand for them reached its highest point in 1856, yet there was more expense and inconvenience in attending them than in the fourth set, so that at most it was only from 1856 that I have really begun to derive any material advantage from my process of annealing, and the profits that would otherwise have resulted from it since have been very much less than they would have been but for the two disastrous checks to the general business of the country that occurred in 1857 and again in 1861. The cost of experiments and changes of structures for developing the improvement patented, has exceed-
722 ed the profits, as before stated, thus:

Say expenses	$52,970 31
" profits	38,346 00
Deficit	$14,624 31

Believing that these annealing ovens and their appendages are now as perfect as we can make them, rendering further expenditure (other than for repairs) unnecessary on their account, the profits by saving of metal in the wheels we are likely to make during the seven years' extension of patent, if granted, would be a satisfactory return for the expenses incurred in bringing into successful use this improvement.

ADVANTAGES TO THE PUBLIC.

The total saving of metal in all the wheels made by us, and subjected to this process of annealing, has been shown to be 2,556,400 lbs. Assuming that each of these wheels ran 50,000 miles before being worn out, and we have equal to 63,910,000 tons of 2,000 lbs. carried one mile. The freight, therefore, on this tonnage, has been saved to the railroad public, and at one cent per ton per mile, a fair rate of cost of movement, amounts to $639,100 00

From which should be deducted the difference in value of the worn-out wheels, which, at one cent per lb. on 2,556,400 lbs., is 25,564 00

Leaving the net saving to the railroad public $613,536 00

There is also another and greater benefit to railroads resulting from my invention, that is, the greater durability of my wheels. The annealing process enables me to make wheels of higher tempered iron, and consequently to chill deeper than other makers, therefore they
723 wear longer. From statistics in my possession, I am enabled to state that their average durability exceeds considerably 100,000 miles, and we do not hesitate to guarantee that mileage when fairly used, while the average durability of the wheels of all other makers, in my opinion, does not exceed 50,000 miles, nor the wheels of any of them over 75,000 miles.

A. WHITNEY.

724 STATEMENT A.—*Recapitulation of wheels made, and expenditures.*

Year.	Wheels.		Expenditures.	
	Made each year.	Made to end of each year.	Each year.	To end of each year.
1846	.....	.....	$111 06	$111 06
1847	480	480	2,233 31	2,344 37
1848	3,033	3,513	163 12	2,507 49
1849	6,852	10,365	1,024 45	3,531 94
1850	10,881	21,246	.....	3,531 94
1851	12,965	34,211	10,609 21	14,141 15
1852	14,463	48,674	4,986 04	19,127 19
1853	15,027	63,701	826 68	19,953 87
1854	17,107	80,808	.....	19,953 87
1855	17,142	97,950	.....	19,953 87
1856	33,562	131,512	.....	19,953 87
1857	30,903	162,415	19,585 24	39,539 11
1858	14,764	177,179	3,856 06	43,395 17
1859	24,834	202,013	4,759 66	48,154 83
1860	32,934	234,947	.....	48,154 83
1861	20,693	255,640	.....	48,154 83
Add 10 per ct. for designing, superintendence, &c.	.....	.....	.....	4,815 48
				$52,970 31

725 *Statement showing cost of drawings, models, and all other expenses in procuring patent for annealing wheels.*

1.

1846.			
June	7.	Thomas P. Jones	$25 00
Nov.	16.	Phila. & Reading R. R. Co., for a chill	23 31
Dec.	19.	Expenses to Washington	20 50
1847.			
April	1.	Thomas P. Jones, paid on acc't, Dec. 17th, 1846	10 00
"	"	Thomas P. Jones, paid on acc't, March 13th, 1847	20 00
"	"	Expressage on model to Washington, Dec. 24, 1846	1 75
"	15.	Thomas D. Smith, taking testimony	2 00
May	7.	Expressage on model and drawings sent to T. P. Jones	50
"	"	Thomas P. Jones, application for patent	30 00
July	31.	Do. do. do.	30 00
"	"	Postage on letters and drawings to Thos. P. Jones	30
			$163 36

726 *Statement showing cost of castings made by Marshall & Teal, &c.*

2.

1846.			
Dec.	22.	Marshal & Teal, on acc't	$40 00
"	24.	Moulding model	2 25
1847.			
Jan'y	9.	Marshall & Teal, in full	94 85
"	19.	J. P. Morris & Co., casting model	7 60
"	"	W'm P. Cresson & Co., castings	6 54
July	2.	Geo. Burnham, for work on machine, etc	97 63
Dec.	31.	Marshall & Teal, fitting up flasks, etc	256 06
"	"	W'm P. Cresson & Co., making patterns and castings	120 44
			$648 46

Statement showing cost of experiments at M. W. Baldwin's, in casting and annealing wheels.

3.

1847.			
Dec.	31.	M. W. Baldwin, for experiments with wheels, etc	$20 00
"	"	M. W. Baldwin, cast wheel, 380 lbs., at 3c	11 40
"	"	Do. castings for flasks, 398 lbs. at 3½c.	13 93
"	"	M. W. Baldwin, 2 axles, fitting and hanging 2 pair wheels	44 40
			$89 73

727 *Statement showing cost of erecting first set of annealing ovens at Willow-street foundry.*

4.

1847.				
June	4.	1,000 common bricks		$6 00
"	5.	Lime, 6 bushels		1 14
"	7.	500 common bricks		3 00
"	9.	Geo. J. Souder, on acc't mason work		15 00
"	12.	Do. in full		3 87
"	19.	Chain, blocks, rope, &c		4 37
July	13.	1 set of plates, cast iron ... 1,320 lbs.		
"	"	148 grate bars, " ... 325		
"	"	Damper, " ... 20		
		1,665 lbs. at 3c.,		49 95
"	27.	Sand, 2 loads		40
"	29.	Fire clay, 1 load		87
"	"	Lime, 7½ bushels		1 50
"	30.	3 sets of plates, viz, 12 for bottom, 12 for top; 3 rings and 3 centre plates, 1,372 lbs., per acc't—total, 4,116 lbs.		
		3 sets grate bars, 148 lbs. ea., 325 lbs ... 977		
		3 dampers to chimney ... 165		
		5,258 lbs. at 3c.,		157 74
"	"	Sand, 1 load		20
"	31.	Geo. J. Souder, on acc't mason work		10 00
Aug.	6.	Lime, 7 bushels		1 26
"	9.	Geo. J. Souder, on acc't		30 00
"	"	Fire clay, 1 load		88
		Carried forward		$286 18

728 Brought forward ... $286 18

1847.			
Aug.	10.	Lime, 2 bushels	50
"	16.	Geo. J. Souder, on acc't	30 00
"	18.	Do. do.	13 37
Sept.	24.	Ab'm Miller, fire brick	137 38
Oct.	2.	W'm Jardin, salmon brick	36 26
"	15.	Double block, for raising covers	1 13
"	16.	Treble do. do. do.	1 38
"	28.	Lime, 7 bushels	1 40
Nov.	1.	Geo. J. Souder, on acc't	10 00
"	8.	Lime, 2 bushels	40
"	"	Geo. J. Souder, on acc't	20 00
"	15.	Do. do.	7 00
"	30.	Do. do.	3 00
Dec.	23.	Do. do.	2 50
	31.	Ab'm Miller, fire brick	103 04
		W'm Jarden, red brick	23 40
		Wages of bricklayers and labor, laying 16,476 brick at 1c	164 76

M. W. Baldwin, casings for ovens, 6,715 lbs., at 8c.		537 20
M. W. Baldwin, 2 thin covers, 5 eye bolts, 201 lbs., at 12½c		25 12
M. W. Baldwin, 6 7/10 days' turning disks, at $4		26 80
M. W. Baldwin, 1 day's dressing disks		1 50
Do. repairing doors		10 50
		$1,442 82

729 *Statement showing cost of second set of annealing ovens, as per drawings marked D, including cost of enlarging foundry to make room for them.*

5.

1849.			
Aug.	7.	Bu'lding permit	$ 25
	10.	R. A. & J. J. Williams' scaffold poles and planks	3 87
	13.	Charles Taylor, on account brick-work	35 00
	18.	do. do. do.	75 00
	20.	Carpenter's wages	11 62
	24.	W. H. Johnson, raising rafters	10 00
	25.	Charles Taylor, on account brick-work	60 00
	27.	Carpenter's wages	14 69
Sept.	1.	Tho's Griffin, on account slating roof	60 00
	1.	Charles Taylor, on account brick-work	40 00
	4.	A. Taylor, carpenter's work	9 00
	5.	Wainwright & Gillingham, lumber for rafters	27 45
	10.	A. Taylor, on account carpenter's work	9 00
	13.	" in full " "	6 00
	15.	Charles Taylor, on account brick-work	25 00
	24.	T. Griffin, in full for slating roof	20 89
	29.	Charles Taylor, on account brick-work	50 00
Oct.	16.	Charles Taylor, in full for service and bills paid by him	154 21
Nov.	2.	Neal & Matthews, in full for work and materials	180 29
	3.	William Jarden, in full for brick	104 60
		Carried forward	$896 87

730

		Brought forward	$896 87
Dec.	31.	Cast-iron plates, rings, grates, &c., for three ovens, 13,264 35/100, at 3c	397 93
			1,294 80
		Less—John Murphy, for amount transferred from repairs, hands' account, lumber, &c., and charged to him for altering foundry	520 35
			$774 45

Statement showing cost of wooden cranes and platform to take wheels into the yard, at Willow-street foundry.

6.

1848.		
July 15.	Ed. Heston, on account new crane	$50 00
19.	Rope for swinging new crane	46
Aug. 2.	Ed. Heston, on account new crane	100 00
3.	Ed. Heston, in full for new crane	12 66
1849.		
Aug. 6.	Ed. Heston, on account new crane	10 00
25.	Ed. Heston, on account new crane	65 00
Sept. 8.	Ed. Heston, in full for new crane	75 00
	Platform to yard, say	100 00
		$413 12

731 *Statement showing cost of 40 × 60 of main building on Callowhill street, say one-tenth of the whole.*

7.

1851 and 1852.		
	Main building and portion of lot on which it stands cost, say, for lot	$1,560 00
	One-tenth of main building	3,440 00
		$5,000 00

Statement showing cost of excavating for annealing ovens, 14 feet deep, and building stone wall on three sides 3 feet thick, and on one side of 40 feet, 2 feet thick, on Callowhill street.

8.

1851.		
	Pit for annealing ovens 60 feet long, average 41⅔ feet wide, and 14 feet deep=1,296 cubic yards, at 40c. per yard, for labor in excavating	$518 44
	Stone in wall around annealing ovens, viz: three sides, 158×14×3, and one side 38×14.2—total, 7,700 cubic feet, or 466⅔ cubic perch, at $1 20 per perch	559 99
	Mason's wages for laying 466⅔ cubic perch, at 50c. per perch	233 33
	Carried forward	$1,311 76

732

1861.	Brought forward	$1,311 76
	In consequence of quicksand bottom, the north wall had to be taken down and relaid on wood foundations, sunk 2 feet below the bottom, the cost of which was, at least, twice as much as that of laying it in the first instance, viz: ex-	

cavating $41\frac{2}{3} \times 16 \times 3$ twice, $148\frac{12}{100}$ cubic yards, at 40c. per yard	59 25
Same dimensions of stone wall taken down and relaid, $242\frac{38}{100}$ cubic perch, at 50c. per perch	121 19
	$1,492 20

Statement showing cost of erecting third set of annealing ovens, as per drawings marked 3.

9.

1852.			
Dec. 31.	Amount transferred from "hands' account" to "Callowhill-st. property" for time of men on annealing oven-floors		$221 84
	Castings for ovens, as follow:		
	Fire-fronts for 4 ovens	3,978.00 lbs.	
	Flanges on do	1,987.44 "	
	Bottom and top rings for do	862.52 "	
	Grate bars for small ovens	1,631.72 "	
	Supports for do	851.76 "	
	Large door frames	865.28 "	
	Doors for do	2,059.20 "	
	Bottom plates for small ovens	8,256.24 "	
	Hub in centre of do	329.12 "	
		20,821.28 lbs.	416 42
	Carried forward		$638 26
733			
1852.	Brought forward	20,821.28 lbs.	$638 26
Dec. 31.	Grates and supp'g rings for driving wheel ovens	4,109.36 "	
	Floor plates over all, 15–10 diam. × 1 thick × 4	29,487.04 "	
	Centre column to support	1,393.68 "	
	Two columns at south end of anneal'g oven cellar	1,332.05 "	
	Two girders do. do.	2,517.55 "	
	Two girders north end of anneal'g oven cellar	3,478.80 "	
	Total at 2c. per lb	63,139.76 "	1,262 79
	4 wrought-iron tie-rods for centre column to side walls, 2×18 each $= 753\frac{84}{100}$ lbs., at 7c. per lb		52 77
	Iron stairway to cellar, say		150 00
	Neal, Matthews & Moore, as follows, viz:		
	4 an'g oven cases, flue iron	15,425 lbs.	
	1 an'g oven flue pipe, flue iron	2,775 "	
		18,200 " at 7c.	1,274 00
	12 flanges and 4 dampers, cast iron, 2,687 lbs., at $2\frac{1}{2}$c.		67 18
	Making flange patterns		19 55

	Putting in place cast-iron door frames, 26 days, at $2	52 00
	Putting flanges on small pipes, 10 days, at $2	20 00
	One-half of bill of bolts and nuts for ovens, &c. $44 94	22 47
	Carried forward	$3,142 60

734

1852.	Brought forward	$3,142 60
Dec. 31.	Fire brick, including tiles for oven doors, 7,000 at 3c	210 00
	Fire-brick lining for flue-pipes, wedged, 5,070, at 4c	202 80
	Red brick for lining ovens and filling in between, say 46,750, at $6 per 1,000	280 50
	Red brick in arched floors and paving over all, 31,219, at $8 per 1,000	249 75
	Wages of bricklayers for laying 90,039, at 1c. each	900 39
1853.		
June 30.	Neal, Matthews & Moore, as follows, viz:	
	Making 4 rings for cases, 6,449, at 7c	451 43
	Joint bolts and nuts for pipes, 65, at 7c	4 55
	Making 4 dampers, 5 days, $2	10 00
	Flue iron do., 2d quality, 492, at 5c	24 60
	Small rivets for do., 7, at 10c	70
	Making covers, 1½ days' time, at $2	3 00
	Iron for do., 2d quality, 90, at 5c	4 50
	Small rivets for do., 3, at 12½c	37
July 16.	Sam'l Haines, bricklayers' work, altering ovens	20 50
Aug. 8.	Amount transferred from "Hands' account" to "Callowhill-street property" for work done on annealing ovens and floors, from January 1 to August 1, 1853	307 03
		$5,812 72

735 *Statement showing cost of chimney* 120 *feet high, as per drawings marked A.*

10

1851.		
Aug. 19.	Siter & Bro's, casting for cap and ferriage from Gloucester	$506 19
	Fitting up cap and raising it to its place	50 00
	W'm Wood, painting cap	10 00
	David Rose, pressed brick, 21,250, at $12 per M	255 00
	David Rose, common brick, 84,750, at $7 50 per M	635 62
	Wages of men charged to hands' account	500 00
	Abraham Miller, fire brick	412 70
	Lightning rod and putting it up, 375 lbs., at 10c.	37 50
	T. Armitage, lightning rod point	10 00
	Scaffolding, templets, sand, lime, fire clay, and bricklayers' wages, for laying 106,000 bricks	1,200 00
		$3,617 01

Statement showing cost of erecting a new wooden crane in Callowhill-street foundry.

11.

1851—Estimated cost of crane for use of annealing ovens, including cost of foundations and fixtures attached to building, for holding top in position.....		$500 00

736 *Statement showing cost of removing third set of annealing ovens and erecting others in their stead, as per drawings marked 4.*

12.

1857—Cast iron in 4th set of annealing ovens, viz:		
Plates around foundations.....	11,226.80 lbs.	
36 rings for bottoms of cases.....	6,550.13 "	
Floor plates, including top rings..	85,201.74 "	
Plates around fire boxes.....	14,103.96 "	
75 grate bars, $26\frac{16}{100}$ lbs. each.....	1,962.00 "	
Posts for grates.....	772.05 "	
3 plates in bridge walls of fire boxes	461.57 "	
4 columns to support floor joists...	3,327.48 "	
22 angle pieces for holding floor joists.....	286.66 "	
Floor plates at north end of cellar.	19,613.88 "	
3 columns under driving wheel ovens.....	3,469.79 "	
3 bottom plates for do.....	5,701.49 "	
675 grate bars for do.....	1,485.00 "	
3 plates for top of foundation.....	3,312.97 "	
Casting around stairway opening..	702.00 "	
Escape flues and valves.....	15,685.92 "	
Casting around hoistway.....	435.24 "	
Total at 4c. per lb.....	174,298.68	6,971 95
Carried forward.....		$6,971 95

737

1857.	Brought forward.....	$6,971 95
July 27.	Neal, Matthews & Moore, for work and materials.....	721 51
Aug. 8.	Wrought-iron girders from Phœnix Iron Company.....	284 29
	Tie-rods in foundations and fire boxes, $3,456\frac{57}{100}$ lbs., at 7c.....	248 26
	Small bolts from Hooper & Townsend.....	76 72
	Red brick in foundations and cellar, 22,783, $8 per M.....	182 26
	Red brick for lining ovens, 34,020, at $7 per M.	238 14
	Fire brick for lining flues and ovens, 10,110, at at $38 per M.....	384 18
	Bricklayers' wages for laying 66,913 bricks, at 1c. each.....	669 13

Oct.	24.	Matthews & Moore, for labor and materials furnished		2,005 13
Dec.	31.	Wages paid men, including amount paid for first arrangement, which was afterwards abandoned		2,065 90
		Matthews & Moore, for labor and materials furnished		488 52
1858.				
Dec.	31.	Amount transferred from "Hands' account" to "Callowhill-street property," for work on annealing ovens..	$72 70	
		Replacing stairway	45 96	
		Coal-pit, in yard	15 00	
				133 66
		Carried forward		$14,469 65

738

1858.				
Dec.	31.	Brought forward		$14,469 65
		Castings for coal-pit in yard, 4,000 lbs., at $2\frac{1}{2}$ c.		100 00
		John Agnew, for $22\frac{56}{100}$ cub. perch stone for do., $1 25 per perch		28 87
		Masons' wagers, laying $22\frac{56}{100}$ perch stone for coal-pit, at 50c.		11 28
		Excavating earth for coal-pit, $133\frac{1}{3}$ yards, at 40c.		53 33
		Red brick in arch of coal-pit, 2,160, at $8 per M.		17 28
		Bricklayers' wagers for laying 2,160 brick, at 1c. each		21 60
				$14,702 01

Statement showing cost of the new hydraulic cranes with force pump and apparatus for working, complete.

13

1857.				
May	7.	W'm Sellers & Co., for hydraulic crane and accumulator		$236 75
June	23.	W'm Sellers & Co., for hydraulic crane and accumulator		54 88
July	31.	W'm Sellers & Co., for hydraulic crane and accumulator		512 62
Aug.	31.	W'm Sellers & Co., for hydraulic crane and accumulator		243 50
Sept.	30.	W'm Sellers & Co., for hydraulic crane and accumulator		1,007 19
Oct.	31.	W'm Sellers & Co., for hydraulic crane and accumulator		801 44
		Carried forward		$ 456 38

739

1857.		Brought forward	$ 456 38
Nov.	30.	W'm Sellers & Co., for hydraulic crane and accumulator	1,518 31
Dec.	21.	W'm Sellers & Co., for hydraulic crane and accumulator	572 15
Dec.	31.	W'm Sellers & Co., for hydraulic crane and accumulator	302 41
1858.			
Feb.	22.	W'm Sellers & Co., for hydraulic crane and accumulator	165 94
March	22.	W'm Sellers & Co., for hydraulic crane and accumulator	250 21
April	21.	W'm Sellers & Co., for hydraulic crane and accumulator	119 98
May	17.	W'm Sellers & Co., for hydraulic crane and accumulator	486 53
June	28.	W'm Sellers & Co., for hydraulic crane and accumulator	610 60
June	30.	W'm Sellers & Co., for hydraulic crane and accumulator	26 58
July	31.	W'm Sellers & Co., for hydraulic crane and accumulator	61 50
Sept.	21.	W'm Sellers & Co., for hydraulic crane and accumulator	137 37
Oct.	20.	W'm Sellers & Co., for hydraulic crane and accumulator	80 22
Nov.	25.	W'm Sellers & Co., on acc., hydraulic crane and accumulator	$151 97
Dec.	21.	W'm Sellers & Co., on acc't, hydraulic crane and accumulator	765 81
		Carried forward	$8,105 96

740

1858.		Brought forward	$8,105 96
Dec.	31.	W'm Sellers & Co., on acc't, hydraulic crane and accumulator	618 02
	31.	Wages of men on acc't, charged to hands' account in 1858	15 31
1859.			
Feb.	17.	W'm Sellers & Co., on acc't hydraulic crane and accumulator	889 08
March	21.	W'm Sellers & Co., on acc't hydraulic crane and accumulator	663 98
April	16.	W'm Sellers & Co., on acc't hydraulic crane and accumulator	629 35
June	27.	W'm Sellers & Co., on acc't hydraulic crane and accumulator	686 42
	30.	W'm Sellers & Co., on acc't hydraulic crane and accumulator	776 88
August	24.	W'm Sellers & Co., on acc't hydraulic crane and accumulator	304 29
Sept.	24.	W'm Sellers & Co., on acc't hydraulic crane and accumulator	128 25

Oct.	17.	W'm Sellers & Co., on acc't hydraulic crane and accumulator	308 47
Nov.	26.	W'm Sellers & Co., on acc't hydraulic crane and accumulator	221 39
Dec.	9.	W'm Sellers & Co., on acc't hydraulic crane and accumulator	115 42
	31.	W'm Sellers & Co., on acc't hydraulic crane and accumulator	36 13
			$13,498 95

741 SUMMARY.

Statement	1.	Cost of procuring patent	$163 36
	2.	" patterns made by Marshall & Teal, and others	648 46
	3.	" experiments at M. W. Baldwin's	89 73
	4.	" erecting first set of annealing ovens, Willow street	1,442 82
	5.	" erecting second set of annealing ovens, Willow street	774 45
	6.	" cranes and platform to yard	413 12
	7.	" main building, Callowhill st., occupied by annealing ovens	5,000 00
	8.	" preparing pit for annealing ovens, Callowhill street	1,492 20
	9.	" erecting third set of annealing ovens, Callowhill street	5,812 72
	10.	" chimney 120 feet high	3,617 01
	11.	" wooden crane for annealing ovens.	500 00
	12.	" erecting fourth set annealing ovens	14,702 01
	13.	" hydraulic cranes and accumulator.	13,498 95
			$48,154 83
Add ten per cent. for designing, drawings, and superintendence			4,815 48
			$52,970 31

742 STATE OF PENNSYLVANIA,
City and County of Philadelphia, ss:

ASA WHITNEY, being duly sworn, doth depose and say that the annexed statement and account is correct.

A. WHITNEY.

Sworn and subscribed before me this fourth day of February, A. D. 1862.

CHARLES E. PANCOAST, [L. S.]
Alderman.

In the matter of the application of Asa Whitney, for an extension of letters-patent granted to him on the 25th of April, 1848, for an improvement in car wheels.

Before C'r P.:

JAMES MOORE, being duly affirmed, doth depose and say:

That he is one of the firm of Matthew & Moore, formerly Neal & Matthew, machinists and iron-founders, in the city of Philadelphia. I know Asa Whitney, the inventor of an improved process of manufacturing car wheels, patented April 25th, 1848. Our firm did the iron work, and furnished material for the different annealing furnaces erected by Mr. Whitney. I have examined the account of said Whitney, and I am satisfied that the amount charged therein as having been furnished by Neal & Matthew, embracing items set out in said account, are essentially correct. I was unable to examine all the bills, as one, for no very large amount, however, was mislaid; the account runs through a period of eight or nine years, and the bill was for work done during our former partnership, to the books of which I have not
743 access; but I am satisfied that, as I stated before, the account is essentially correct.

JAMES MOORE.

Sworn and subscribed before me this 18th day of March, A. D. 1862.
JAMES McCAHAN,
Alderman and Justice of the Peace.

In the matter of the application of Asa Whitney, for an extension of letters-patent granted to him on the 25th day of April, 1848, for an improvement in car wheels.

Before C'r P.:

WILLIAM SELLERS, being duly sworn, doth depose and say:

That I am senior partner in the firm of William Sellers & Co., of Philadelphia; that I know Mr. Asa Whitney, and have known him for many years; I have frequently visited his works for making car wheels, in the city of Philadelphia, and have built his machinery for manufacturing his improved wheels; I have read the account of expenses of machinery pertaining to the manufacture of his patented wheels, and the items in

Statement No. 5, amounting to	$744 45
The items in Statement No. 6, amounting to	413 12
" " " " " 9, " "	5,812 72
" " " " " 11, " "	500 00
" " " " " 12, " "	14,702 01
" " " " " 13, " "	13,498 95

are amounts, the correctness of which is within my knowledge; the other items are not within my knowledge. I have been familiar with the manufacture of iron in its various forms for many years; I am also familiar with the mode of making car wheels invented by said Asa Whitney, and I regard it as a very valuable improvement; my
744 attention has also been directed to its practical value on railroads, as a director of a railroad company which used said Whitney's patented wheels, and I consider it a great saving to railroad companies. I have read the statement of Mr. Asa Whitney, setting forth

the advantages of this improvement, and filed in the Patent Office, and I believe it to be true and correct; I cannot place a money value on the improvement, however, as railroad engineers can do.

W'M SELLERS.

Sworn and subscribed before me this 18th day of March, A. D. 1862.

JAMES McCAHAN,
Alderman and Justice of the Peace.

In the matter of the application of Asa Whitney for an extension of letters-patent granted to him on the 25th April, 1848, for an improvement in car wheels.

Before C. P.:

CHARLES TAYLOR, being duly affirmed, doth depose and say:

I am a bricklayer, and reside in the city of Philadelphia, and have resided there for many years; I know Asa Whitney, the patentee, and have known him for many years; I am acquainted with his patented process for making wheels; I have constructed the brick-work for the second, third, and fourth sets of annealing ovens used by him, and mentioned in the summary of expenses in said Asa Whitney's account, and have also superintended the masonry for said Whitney's present car-wheel works; and I have examined the statement of expenses of Asa Whitney in his application for an extension of his letters-patent, and the items of expense pertaining to said structures are within my knowledge, and are just and correct; these items relate to the second, third and fourth sets of annealing ovens, and so much of the building
745 as is appropriate to the annealing of car wheels; all these items of expense were rendered necessary for the carrying out and perfecting the patented process of making said Whitney's improved car wheels.

CHARLES TAYLOR.

Affirmed and subscribed before me this 18th day of March, A. D. 1862.

JAMES McCAHAN,
Alderman and Justice of the Peace.

In the matter of the application of Asa Whitney for an extension of letters-patent granted to him on the 25th day of April, 1848, for an improvement in car wheels.

Before C. P.:

J. DUTTON STEELE, being duly sworn, doth depose and say:

I am a civil engineer by profession, and have been engaged on the Philadelphia and Reading Railroad for fifteen years; part of the time as superintendent and engineer, and part of the time as vice-president. I have given considerable attention to the subject of car wheels, in connection with that road. I am well acquainted with the invention of Asa Whitney for manufacturing car wheels, patented to said Whitney, April 25, 1848. I have long been practically acquainted with the value of wheels made under Mr. Whitney's patent. The Reading Railroad Company has used many wheels not made under his patent. It has also used many wheels made by Whitney, under his patent aforesaid. The

Philadelphia and Reading Railroad Company make many wheels themselves which are not made under his patent, but they do not trust any wheels under passenger cars but Whitney's patented wheel aforesaid.

746 I consider the Whitney wheel less liable to fracture, and therefore safer. I have no doubt that the extensive use of these wheels under passenger cars has tended greatly to diminish the risk of accidents and the loss of life and limb on our railroads.

The statistics of wheels on the Reading Railroad during a period of ten years, show that the wheels manufactured under the patented process of said Whitney, will run over 100,000 miles, while those manufactured without his process, run about 50,000 miles.

There is no doubt that Mr. Whitney's wheel, with a diminished weight, possesses superior strength over other wheels. On the average roads of the country, I think that one cent per ton per mile on the excess of weight in other wheels than Whitney's, over Whitney's wheel, would be a fair estimate of the saving to the railroad interest of the country, in a money point of view, of the use of his wheels. This advantage is, of course, additional to the diminished liability to accidents, a consideration of great importance, in a financial point of view, to railroad companies.

J. DUTTON STEELE.

Sworn and subscribed before me this 18th day of March, A. D. 1862.

JAMES McCAHAN,
Alderman and Justice of the Peace.

In the matter of the application of Asa Whitney for an extension of letters-patent granted to him on 25th April, 1848, for an improvement in car-wheels.

Before C. P.:

JOHN MURPHY, being duly sworn, doth depose and say:

747 I am a member of the firm of Murphy & Allison, car builders, in the city of Philadelphia, and have been engaged in car building since 1833. I have used an immense number of car wheels of all varieties of patterns, and made by various processes of construction. I am familiar with the car wheel manufactured by Asa Whitney, according to the process patented by him April 25, 1848. I have known Asa Whitney for many years; many of his experiments were made by him during the five years he occupied, as a tenant, a building which I owned. He built, to my knowledge, during those five years, two sets of furnaces for experimenting, and afterwards tore them down and built others at considerable expense. His process, although very complete, yet required ovens of very nice construction to secure the perfect manufacture of all the wheels placed in them. As the number of wheels required increased, he was constantly obliged to change his ovens to avoid defective wheels being produced. He also replaced any defective wheels which he manufactured, by a good wheel, at his own expense, during the time of these experimental ovens. At the time of Mr. Whitney's patent, car wheels were made at nearly every point, of any size, along the lines of the railroad, wherever there was a foundry. The sectional prejudices of these manufacturers was united against this wheel. The report was industriously circulated by these parties that the process by which Mr. Whitney's wheels were manufactured would soften the wheels on the chilled or outer portion of the wheel. This was not true in fact, as I now know by long continued use of these wheels; but the industrious

circulation of this report by numerous rival manufacturers, created a prejudice among railroad companies against the wheel, which required some years to remove, and which, in fact, with some railroad companies, has only been removed within the last two years. I regard Mr. Whitney's wheel, as manufactured by his patented process, as far superior to any other wheel. I have compared, by actually weighing Mr. Whitney's wheel with numerous other wheels, and I find that, taking the
748 diameter of wheels, (33-inch,) most frequently used by me, there is a difference in favor of Mr. Whitney's wheel of from ten to fifteen pounds in lightness. His wheels are stronger, at the same time less liable to break, and will run considerably longer than other wheels. I know of some wheels of Mr. Whitney's, now in use, that have been running for some eight to ten years. A difficulty which prevented the general introduction of Mr. Whitney's wheel at an earlier date, was that the railroad companies could not, without a long comparative trial of his wheels with other wheels, be practically satisfied with the durability of his wheels. He could not by an exhibition of his wheel, or an inspection of its exterior, demonstrate the advantage due to his mode of manufacture, and it was only by demonstrating, on the few roads which he could succeed in inducing to try it, after the lapse of some years of comparative trial, that they were so far superior to other wheels in strength and durability.

JOHN MURPHY.

Sworn and subscribed before me this 18th day of March, A. D. 1862.

JAMES McCAHAN,
Alderman and Justice of the Peace.

STATE OF PENNSYLVANIA,
City and County of Philadelphia, ss:

At Philadelphia, in said county, on the 18th day of March, A. D. 1862, before me, personally appeared the above-named J. Dutton Steele, Charles Taylor, William Sellers, James Moore, and John Murphy, and severally made oath or affirmation respectively, that the foregoing depositions, signed by them respectively, contain the whole truth, and nothing but the truth.

The said depositions are taken at the request of Asa Whitney,
749 to be used at the hearing of his application for an extension of the letters-patent granted to him on the 25th day of April, 1848, for an improvement in car wheels, before the Commissioner of Patents of the United States, on the day of April next; that as there were no opponents to his said application, there was no notice of the time and place of taking the same given to any one.

JAMES McCAHAN,
Alderman and Justice of the Peace.

In the matter of the application of Asa Whitney for an extension of letters-patent, granted April 25th, 1848.

JOHN MURPHY, being recalled and duly sworn, doth depose and say:

I have been purchasing large numbers of car wheels of all kinds since 1834. I am familiar with the prices of various wheels. The annexed list of prices of the Whitney wheels is correct.

Mr. Whitney has kept the price of his wheels below that of most other makers, thereby saving to the public in that respect, of cost, at

the same time that his wheels possessed the superior qualities of durability and strength, united to lightness, of which I have spoken in my former affidavit.

The effect of Mr. Whitney supplying the public with a superior wheel at a reduced price has compelled the other manufacturers of wheels to come down to the prices which he has established from time to time.

I would think eleven dollars and a half per wheel would be a fair average price to put the wheels of the country at for the present time, taking the various railroads.

JOHN MURPHY.

Sworn and subscribed before me this 21st day of March, A. D. 1862.

JAMES McCAHAN,
Alderman and Justice of the Peace.

750 *Prices of A. Whitney & Sons' wheels, delivered at Philadelphia at 3 and 4 months' credit.*

Date when price was fixed.	30″ wheels. about.	33″ wheels. about.	36″ wheels.
1847.	$14½, (350 lbs.)	$15, (385 lbs.)	$16, (430 lbs.)
Jan'y 1, 1849.	14½, (425 lbs.)	15½, (465.)	
" 1, 1850.	13½	14½	
" 1, 1851.	13	14	
Oct'r 1, 1851.	12½	14	
Jan'y 1, 1852.	12	13	
" 1, 1853.	12½	13½	
June 1, 1853.	13½	14½	
Feb'y 1, 1855.	13	14	
M'ch 2, 1857.	12	13½	
Jan'y 1, 1858.	12	13	
Ap'l 15, 1858.	11½	12½	
" 14, 1860.	11	12½	
June 1, 1861.	10¾, (430 lbs.)	12¼, (490 lbs.)	13¼, (630 lbs.)

In the matter of the application of Asa Whitney for an extension of letters-patent, granted April 25th, 1848.

JOHN H. REDFIELD, being duly sworn, doth depose and say:

That he is a book-keeper in the employ of Asa Whitney; that he has examined the record book in which the number of patented wheels made under Asa Whitney's patent is kept; that he has examined the account filed by Asa Whitney, in which the number of wheels made each year is set forth, and showing an aggregate of 255,640 wheels to January 1st, 1862, and that the same is correctly taken from the books of said Asa Whitney.

JOHN H. REDFIELD.

Sworn and subscribed before me this 22d day of March, A. D. 1862.

JAMES McCAHAN,
Alderman and Justice of the Peace.

751 STATE OF PENNSYLVANIA,
City of Philadelphia, ss:

On this 22d day of March, A. D. 1862, personally appeared before me, the subscriber, an alderman and justice of the peace of said city, the above-named John Murphy and John H. Redfield, and William Helme, and severally made oath respectively, that the foregoing depositions, signed by them respectively, contain the truth, the whole truth, and nothing but the truth.

The said depositions are taken at the request of Asa Whitney, to be read at the hearing of his application for an extension of the letters-patent granted to him on the 25th day of April, A. D. 1848, for an improvement in car wheels, before the Commissioner of Patents of the United States, at his office, on the day of April; that as there were no opponents to his said application, there was no notice given of the time and place of taking the same to any one.

Witness my hand and seal the day and year aforesaid.

[SEAL.] JAMES McCAHAN,
Alderman and Justice of the Peace.

I hereby certify that the depositions of James Moore, William Sellers, Charles Taylor, James D. Steele, John Murphy, and John H. Redfield, in the matter of the application of Asa Whitney for an extension of letters-patent granted April 25th, 1848, were taken, sealed up, and addressed to the Commissioner of Patents by me.

Witness my hand and seal this 22d day of March, A. D. 1862.

[SEAL.] JAMES McCAHAN,
Alderman and Justice of the Peace.

Received and filed March 24, 1862. E. W. W. G.

752 Circuit court of the United States, southern district of Ohio. In equity.

ASA WHITNEY *vs.* ALBERT L. MOWRY. } No. 534.

To the honorable the judges of the circuit court of the United States within and for the sixth circuit and southern district of Ohio, in chancery sitting:

The undersigned, special master, respectfully reports that under the order entered in the above-entitled cause October 22, 1868, he has taken the depositions of William Cullen, Jerry O'Donnell, James Lamb, William Clough, Alvin A. Stone, Charles B. Collier, Albert L. Mowry, Samuel First, and David P. Green, witnesses produced before him by the parties, and herewith files the same. And there have been taken and submitted to him the depositions of George G. Lobdell, Horatio G. Brooks, William W. Snow, William Kidd, Asa Whitney, George Burnham, Charles T. Parry, and George H. Kirk, which are also herewith filed. There have also been offered in evidence, and filed as exhibits, the following certified copies, which are herewith filed:

Certified copy of reissued letters-patent, granted Anson Atwood, dated 22d September, 1857, number 497, for cast-iron railroad wheels.

753 2. Certified copy of letters-patent, granted John Murphy dated August 7, 1849, number 6,633, for improved method of regulating the contraction of car wheels.

3. Certified copy of letters-patent, granted Anson Atwood, dated 15th May, 1847, number 5,112, for cast-iron railroad wheels.

4. Certified copy of reissued letters-patent, granted Anson Atwood, dated 9th June, 1857, number 468, and the certificate of extension, for railroad car wheels.

5. Certified copy of letters-patent to Nathan Washburn, dated 18th October, 1850, number 7,710, for Washburn's improved car wheels.

6. Certified copy of reissued letters-patent granted Anson Atwood, dated 22d September, 1857, number 498, for cast-iron railroad wheels.

As to "what proportion, if any, of the profit made by the said defendant was due to the use by him of the complainant's invention," the master reports that the answer to this inquiry depends upon the construction which the court shall give to the complainant's invention.

I. If, as is claimed by complainant's counsel, the entire process of reheating and prolonged cooling used by the defendant in the manufacture of the nineteen thousand eight hundred and nineteen (19,819) cast-iron car wheels, referred to by the master in the first finding of his original report herein, was an invasion of the complainant's invention, the master finds that the total profit derived by the defendant from the manufacture and sale of said wheels was due to the use by him of the complainant's invention.

The master remarks in this connection that no testimony has been offered to enable him to make an apportionment of the total profit, so as to credit a portion to the material used, and to the processes
754 employed in the manufacture up to the time of the removal of the wheels from the moulds, and the remainder to the processes of reheating and slow-cooling; and it is insisted by counsel for each party, that such a division is impossible.

II. If, as is claimed by defendant's counsel, there is no infringement of the complainant's patent, unless the wheels are subjected to the process of reheating—that is to say, if the process of slow-cooling used in connection with the reheating is old, and not a part of the complainant's invention, the master finds that no part of the profit derived by the defendant from the manufacture and sale of said wheels was due to the use by him of the complainant's invention.

III. The master finds that if said wheels, manufactured by the defendant, had been left to cool in the open air, they would have had no market value as car wheels; they would have been worth only the value of the iron of which they were made. Reheating, in connection with slow-cooling, or slow-cooling without reheating, is indispensable to make marketable cast-iron car wheels of the configuration of those made by the defendant.

IV. The master finds that there is no reheating process for the manufacture of car wheels outside of the complainant's patent.

V. The master finds that the wheels aforesaid could have been manufactured without being subjected to the reheating process—

1st. By removing them from the moulds as soon as they could be handled, and slow-cooling them by placing them in pits, and covering them with hot sand.

2d. By removing them from the moulds as soon as they could be handled, placing them in pits, without any fuel, covering the pits, leaving the wheels in the pits four or five days, thus retarding
755 the cooling, and then removing them and allowing them to cool in the open air.

The master finds that wheels so manufactured have, and did have from April 1, 1861, to April 7, 1867, a market value equal to that of

wheels manufactured by the use of the process complained of in this cause.

Respectfully submitted.

GEORGE R. SAGE,
Special Master.

756 United States circuit court, southern district of Ohio, in equity.

ASA WHITNEY
vs.
ALBERT L. MOWRY. } 534

To the honorable the judges of the circuit court of the United States within and for the sixth circuit and southern district of Ohio, in chancery sitting:

The undersigned reports to the court that a few days prior to the filing of his report last filed herein, he submitted to counsel a draft report embodying substantially the propositions stated in the report filed, excepting the propositions & findings requested by counsel; to this draft report counsel for complainant submitted exceptions, which, upon his request, are herewith filed.

Respectfully submitted.

GEO. R. SAGE,
Special Master.

757 United States circuit court, southern district of Ohio. In equity.

ASA WHITNEY
vs.
ALBERT L. MOWRY.

Exceptions to the draft report of the master, under the order of the court, entered in this cause October 22, 1868.

Counsel for complainant respectfully submit to the master the following exceptions to his said draft report, and pray that he will amend and alter said draft report accordingly:

To the following finding of said draft report, to wit:

"II. If, as is claimed by defendant's counsel, there is no infringement of the complainant's patent, unless the wheels are subjected to the process of reheating—that is to say, if the process of slow-cooling used in connection with the reheating is old, and not a part of the complainant's invention, the master finds that no part of the profit derived by the defendant from the manufacture and sale of said wheels was due to the use by him of the complainant's invention."

Counsel for complainant except:

1st. Because there is no evidence to show that the process of slow-cooling was old, nor to justify the master in finding that it was old.

2d. Because, in point of fact, not only the entire process described
758 in the patent, but each part of such entire process, was the invention of the complainant; and the use of any material, substantial, and essential part of such entire process—the slow-cooling being a substantial, material, and essential part—whereby, only, an improved chilled cast-iron railroad-car wheel could be made, and beneficial effects the same in kind, if not in degree, attained that were attained by the

complainant's entire process, is an infringement of complainant's patent, and the profits derived from the use of such material, substantial, and essential part should be accounted for in this case.

And thereupon complainant's counsel pray the master will report to the court all the evidence in any way relating to this finding should he not allow this exception to his draft report.

3d. Because it is not a legitimate subject of inquiry what would have been the possible profits from using some other than the patented process; but the true inquiry is, what were the actual profits from using the patented process which the defendant did use.

4th. Because the evidence does not warrant the master in finding that the defendant would or could have made, by using the slow-cooling alone, the same profit which he did actually realize from using the entire process, which the defendant did in fact use.

And hereupon complainant's counsel pray the master will report to the court all of the evidence in any way bearing on this question, (and especially the tables of iron purchased from May, 1867, to October 31st, 1868, pp. 126, 127, and 128, and the tables of wheels sold from April, 1867, to October, 1868, p. 121, forming part of Samuel First's deposition of October 31st, 1868,) should he not allow this exception to his draft report.

To the following finding of said draft report, to wit:

"V. The master finds that the wheels aforesaid could have been
759 manufactured without being subjected to the reheating process—1st. By removing them from the moulds as soon as they could be handled, and slow-cooling them by placing them in pits and covering them with hot sand. 2d. By removing them from the moulds as soon as they could be handled, placing them in pits without any fuel, covering the pits, leaving the wheels in the pits four or five days, thus retarding the cooling, and then removing them and allowing them to cool in the open air."

Complainant's counsel except:

1st. Because the testimony shows that the hot-sand process is an annealing or reheating process, and none of the evidence warrants the master in finding that it is not a reheating process.

And thereupon the complainant prays the master will report to the court all of the evidence in any way bearing on this finding, (and especially the deposition of George G. Lobdell, of December 9, 1868, and the answer to cross-question 47, p. 196, of A. Whitney's deposition of December 21, 1868,) should he not allow this exception to his draft report.

2d. Because the evidence does not warrant the master in finding that placing the wheels together in a covered pit hermetically sealed does not attain in some degree the benefit of re-heating, or of the re-heating process described in the complainant's patent, and by the use of a substantial part of the means therein indicated.

3d. Because, in point of fact, not only the entire process described in the patent, but each part of the entire process, was the invention of the complainant, and the use of any material, substantial, and essential part thereof, (the slow-cooling in such covered pits being such a substantial, material, and essential part,) whereby an improved chilled cast-iron rail-road car wheel could be made, and beneficial effects, the same in
760 kind, if not in degree attained, that were attained by the complainant's entire process, is an infringement of complainant's patent, and the profits derived from the use of such material, substantial, and essential part should be accounted for in this case.

And thereupon the complainant prays the master will report to the court all the evidence in any way relating to this finding, should he not allow this exception to his draft report.

And to the following finding of said draft report, to wit:

"The master finds that wheels so manufactured have and did have, from April 1, 1861, to April 7, 1867, a market value equal to that of wheels manufactured by the use of the process complained of in this cause."

Complainant's counsel except:

Because the evidence does not warrant the master in finding that wheels so manufactured have and did have a market value equal to that of wheels manufactured by the use of the process patented to the complainant.

And thereupon the complainant prays the master will report to the court all the testimony in any way relating to this finding, should he not allow this exception to his draft report.

All of which is respectfully submitted.

HENRY BALDWIN, JR.,
Of Counsel for Complainant.

761 Circuit court of the United States, southern district of Ohio. In equity.

ASA WHITNEY
vs.
ALBERT L. MOWRY. } No. 534.

To the honorable the judges of the circuit court of the United States within and for the sixth circuit and southern district of Ohio, in chancery sitting:

The undersigned special master respectfully reports that under the order entered in the above-entitled cause October 22, 1868, he has taken the depositions of William Cullen, Jerry O'Donnell, James Lamb, William Clough, Alvin A. Stone, Charles B. Collier, Albert L. Mowry, Samuel First, and David P. Green, witnesses produced before him by the parties, and herewith files the same. And there have been taken and submitted to him the depositions of George G. Lobdell, Horatio G. Brooks, William W. Snow, William Kidd, Asa Whitney, George Burnham, Charles T. Parry, and George H. Kirk, which, with the exhibits, transcripts, tables, statements, and documents referred to by the witnessess, and annexed to their depositions, are also herewith filed. There have also been offered in evidence, and filed as exhibits, the following certified copies, which are herewith filed:

1. Certified copy of reissued letters-patent granted Anson Atwood, dated 22d September, 1857, number 497, for cast-iron railroad wheels.

762 2. Certified copy of letters-patent granted John Murphy, dated August 7th, 1849, number 6,633, for improved method of regulating the contraction of car wheels.

3. Certified copy of letters-patent granted Anson Atwood, dated 15th May, 1847, number 5,112, for cast-iron railroad wheels.

4. Certified copy of reissued letters-patent granted Anson Atwood, dated 9th June, 1857, number 468, and the certificate of extension for railroad-car wheels.

5. Certified copy of letters-patent to Nathan Washburn, dated 18th October, 1850, number 7,710, for Washburn's improved car wheels.

6. Certified copy of reissued letters-patent granted Anson Atwood, dated 22d September, 1857, number 498, for cast-iron railroad wheels.

Also, certified copy of statement and account of Asa Whitney, and of his argument in the matter of his application for an extension of letters-patent granted to him April 25, 1848, for improvement in annealing and cooling cast-iron car wheels; also of the examiner's report thereupon.

To the first proposition submitted by the court to the master, to ascertain and report to the court "what proportion, if any, of the profit made by the said defendant was due to the use by him of the complainant's invention," the master reports that no testimony has been offered to enable him to make an apportionment of the total profit derived from the manufacture by the defendant of the nineteen thousand eight hundred and nineteen cast-iron car wheels referred to by the master in the first finding of his original report herein, so as to credit a portion to the material used and to the processes employed in their manufacture up to the time of their removal from the moulds, and the remainder to the processes of
763 reheating and slow-cooling; and the master is therefore unable to report any division of profits. The master further reports that the questions submitted to him have been argued by counsel, and they differ widely as to what is included in the complainant's invention and patent, and as to the construction of the patent by the court. The master does not consider it within his province to attempt to construe the patent, and therefore reports in the alternative.

I. If, as is claimed by complainant's counsel, the entire process of reheating and prolonged cooling used by the defendant in the manufacture of said wheels was an infringement of the complainant's patent, the master finds that the total profit realized by the defendant from the manufacture and sale of said wheels was due to the use by him of the complainant's invention.

II. If, as is claimed by defendant's counsel, there is no infringement of the complainant's patent unless the wheels are subjected to the process of reheating—that is to say, if the process of slow-cooling used in connection with reheating is old, and not a part of the complainant's invention, nor included in his patent, the master finds that no part of the profits realized by the defendant from the manufacture and sale of said wheels was due to the use by him of the complainant's invention.

III. The master finds that had said wheels, manufactured by the defendant, been left to cool in the open air they would have had no market value as car wheels; they would have been worth only the value of the iron of which they were made. Reheating in connection with slow-cooling, or slow-cooling without reheating, is indispensable to make marketable cast-iron car wheels of the configuration of those made by the defendant.

IV. The master finds that there is no reheating process for the manufacture of cast-iron car wheels outside of the complainant's patent.

764 V. The master finds that the wheels aforesaid could have been removed from the moulds and finished without being subjected to the reheating process:

1st. By placing them in pits as soon as they could be handled, covering them with hot sand, and thereby slow-cooling them.

2d. By placing them in like manner in pits without any fuel, covering the pits, leaving the wheels in the pits, and thereby slow-cooling them.

The master finds that wheels so manufactured have, and did have

from April 1st, 1861, to April 7th, 1867, a market value equal to that of wheels manufactured by the use of the process complained of in this cause.

Complainant's counsel asks for the following findings:

1st. That the wheels of which the master has taken an account, made and sold by the defendant, were annealed wheels, and were sold as annealed wheels.

This I adopt as a finding and hereby report it as such to the court.

2d. That the process patented to the complainant, and, as found by the court, used by the defendant in the manufacture of said wheels, conferred upon them their entire market value and their entire value above their weight in iron.

If the court shall decide that the complainant's patent includes prolonging the time of cooling the wheels, as used by the defendant, I adopt this as a finding; but if the complainant's patent covers only the application of extraneous heat to the wheels after they are taken from the moulds, I decline to make this finding.

3d. That no process of annealing in connection with prolonging cooling of cast-iron car wheels, other than that patented to the complainant April 5th, 1848, and that described in the patent of May, 1861, appears to be or to have been known in the manufacture of cast-iron car wheels.

765 Taking annealing to mean reheating in connection with slow-cooling, I adopt this as a finding, and report it as such.

4th. That the said wheels made by the defendant required no treatment other than that described in the said patent of complainant, to complete them as annealed wheels.

This I adopt as a finding, and report it as such to the court.

5th. That the said annealed wheels made and sold by the defendant could not have been made by any process outside of the complainant's patent.

This will be considered in connection with the requests by counsel for defendant, as follows:

I am requested by counsel for defendant to embody in my report the specific inquiries addressed to me by the court, and to answer them in the affirmative or negative, as the fact may appear:

"First. Whether the wheels made and sold by the defendant had, or could have been made to have, any market value without being subjected to the process patented to the complainant."

"Second. If they had, or could have been made to have such value, by any annealing or slow-cooling process outside of the complainant's patent, how much additional and greater market value, if any, they derived from being subjected to said patented process?"

I find that said annealed wheels—using the term annealed in the sense above indicated—could not have been made by any process outside of the complainant's patent.

The application of extraneous heat in the manner described in the complainant's patent, and as used by the defendant in the manufacture of said wheels, retrieves the metal in some degree from the strain which begins the moment the wheels are cast, and in so far as that is accomplished the wheels are strengthened, and their liability to break

766 overcome. This retrieving is accomplished only by the application of extraneous heat, and extraneous heat cannot be applied without infringing the complainant's patent.

Precisely the wheels, then, that the defendant manufactured could

not have been manufactured without using the process patented to the complainant, or its equivalent.

But I find that wheels of the material, size, shape, and weight of those manufactured by the defendant could have been manufactured without the use of extraneous heat, and at less cost, by either of the methods described in finding V of this report, and that wheels so manufactured would have had the same market value in the market where the defendant sold said 19,819 car wheels, as if extraneous heat had been applied to them, as described in the complainant's patent, or as used by the defendant.

Respectfully submitted.

GEO. R. SAGE,
Special Master.

MARCH 23D, 1869.

Master's fees upon recommittal, $1,000 00.

767 United States circuit court, southern district of Ohio. In equity.

ASA WHITNEY
vs.
ALBERT L. MOWRY.

Complainant's exceptions to the report of George R. Sage, esq., special master, (filed March 24, 1869,) under the order of the court entered in this cause, Oct. 22, 1868.

Having taken objections to the draft of said report, and said objections so taken having been overruled by the master, the complainant now takes to this honorable court, exceptions to said report, as returned and filed by said master, in the following particulars, to wit:

To the following finding of said report, viz:

"II. If, as is claimed by defendant's counsel, there is no infringement of the complainant's patent unless the wheels are subjected to the process of reheating—that is to say, if the process of slow-cooling used in connection with the reheating is old, and not a part of the complainant's invention, nor included in his patent, the master finds that no part of the profits realized by the defendant from the manufacture and sale of said wheels was due to the use by him of the complainant's invention."

768 Complainant excepts:

1st. Because there is no evidence to show that the process of slow-cooling was old, nor to justify the master in finding that it was old.

2d. Because, in point of fact, not only the entire process described in the patent, but each part of such entire process, was the invention of the complainant, and the use of any material, substantial, and essential part of such entire process—the slow-cooling being a substantial, material, and essential part—whereby, only, an improved chilled cast-iron railroad car wheel could be made, and beneficial effects, the same in kind if not in degree, attained, that were attained by the complainant's entire process, is an infringement of complainant's patent, and the profits derived from the use of such material, substantial, and essential part should be accounted for in this case.

3d. Because it is not a legitimate subject of inquiry what would have

been the possible profits from using some other than the patented process; but the true inquiry is, what were the actual profits from using the patented process which the defendant did use.

4th. Because the evidence does not warrant the master in finding that the defendant would or could have made, by using the slow-cooling alone, the same profit which he did actually realize from using the entire process which the defendant did in fact use.

To the following finding of said report, viz:

"V. The master finds that the wheels aforesaid could have been removed from the moulds and finished without being subjected to the reheating process:

769 "1st. By placing them in pits as soon as they could be handled, covering them with hot sand, and thereby slow-cooling them.

"2d. By placing them in like manner in pits without any fuel, covering the pits, leaving the wheels in the pits, and thereby slow-cooling them."

Complainant excepts:

1st. Because the testimony shows that the hot-sand process is an annealing or reheating process, and none of the evidence warrants the master in finding that it is not a reheating process.

2d. Because the evidence does not warrant the master in finding that placing the wheels together, in a covered pit hermetically sealed, does not attain in some degree the benefit of reheating, or of the reheating process described in the complainant's patent, and by the use of a substantial part of the means therein indicated.

3d. Because, in point of fact, not only the entire process described in the patent, but each part of the entire process, was the invention of the complainant, and the use of any material, substantial, and essential part thereof, (the slow-cooling in such covered pits being such a substantial, material, and essential part,) whereby only an improved chilled cast-iron railroad car wheel could be made, and beneficial effects, the same in kind if not in degree, attained that were attained by the complainant's entire process, is an infringement of complainant's patent, and the profits derived from the use of such material, substantial, and essential part should be accounted for in this case.

770 To the following finding of said report, viz:

"The master finds that wheels so manufactured have and did have from April 1st, 1861, to April 7th, 1867, a market value equal to that of wheels manufactured by the use of the process complained of in this cause."

Complainant excepts:

Because the evidence does not warrant the master in finding that wheels so manufactured have and did have a market value equal to that of wheels manufactured by the use of the process patented to the complainant.

And to the following finding of said report, viz:

"But I find that wheels of the material, size, shape, and weight of those manufactured by the defendant could have been manufactured without the use of extraneous heat, and at less cost, by either of the methods described in finding V of this report, and that wheels so manufactured would have had the same market value, in the market where the defendant sold said 19,819 car wheels, as if extraneous heat had been applied to them, as described in the complainant's patent, or as used by the defendant."

Complainant excepts:

Because the evidence does not warrant the master in finding that wheels of the size, shape, and weight of those manufactured by the defendant could have been manufactured without the use of extraneous heat, and at less cost, by either of the methods described in finding V of said report, and that wheels so manufactured would have had the same market value in the market where the defendant sold said
771 19,819 car wheels, as if extraneous heat had been applied to them as described in the complainant's patent, or as used by the defendant.

In which foregoing particulars said complainant submits that said report ought to be amended and altered as aforesaid.

HENRY BALDWIN, JR., *of Counsel.*

APRIL 20, 1869.

772 Circuit court of the United States, southern district of Ohio, in equity.

ASA WHITNEY
vs. } 534
ALBERT L. MOWRY.

The defendant above named, by his counsel, excepts to each and every part of the report of the special master in said cause, dated March 23, 1869, except those parts thereof hereinafter quoted, to wit:

"V. The master finds that the wheels aforesaid could have been removed from the moulds and finished without being subjected to the reheating process—

"1st. By placing them in pits as soon as they could be handled, covering them with hot sand, and thereby slow-cooling them.

"2d. By placing them in like manner in pits, without any fuel, covering the pits, leaving the wheels in the pits, and thereby slow-cooling them.

"The master finds that the wheels so manufactured have, and did have from April 1st, 1866, to April 9, 1867, a market value equal to that of wheels manufactured by the use of the process complained of in this cause." * * * * * * * *

"But I find that wheels of the material, size, shape, and weight of those manufactured by the defendant could have been manufactured without the use of extraneous heat, and at less cost by either of the methods described in finding V of this report, and that wheels so manufactured would have had the same market value, in the market
773 where the defendant sold said 19,819 car wheels, as if extraneous heat had been applied to them as described in the complainant's patent, or as used by the defendant."

And the defendant excepts to finding "I" of said report, inasmuch as it assumes that no interpetration or construction has been given to the complainant's patent by the court, whereas an interpetration had been so given, as was well known to the master, and the construction placed on said patent by the master, as the hypothesis of said finding, is directly in conflict with the court's construction, and said finding is therefore contemptuous of the court.

Again, upon any construction of said patent, said finding is wholly unwarranted by the testimony, or by any part of it.

And the defendant excepts to findings "III," "IV," and to all that part of the reports which commences with the words "Complainant's counsel asks for the following findings;" and ends with the words "Precisely the wheel, then, that the defendants manufactured could not

have been manufactured without using the process patented to the complainant, or its equivalent."

And the defendant, by way of stating more specifically his exceptions, refers to the first inquiry addressed to the master as contained in the order of the court, to wit:

"First. Whether the wheels made and sold by the defendant had, or could have been made to have, any market value without being subjected to the process patented to the complainant?"

And says that the master has refused to answer such inquiry categorically, as requested by defendant's counsel, and, instead of so answering, has inserted an argumentative finding, which conveys, by way of implication, that which is calculated to deceive and mislead the court.

774 And the defendant excepts to so much of said findings and report as may be construed to mean that the 19,819 car wheels made and sold by the defendant had any greater market value by reason of the application to them of extraneous heat in the annealing pits than they would have had if they had been left to cool there by a retention of their own heat; for the reason that the entire testimony taken pursuant to the order of the court, including the testimony of the complainant, shows that no additional market value is given to car wheels by the application to them of extraneous heat in the process of cooling them.

And the defendant craves leave to refer to the testimony offered before the master, and filed by him, at the hearing hereof.

CHAS. B. COLLIER,
Solicitor for Defendant.

Filed April 17th, 1869.

JOHN McLEAN, *Clerk.*

(A copy.)

775 U. S. circuit court, southern district of Ohio.

Motion to set aside decree and for a rehearing.—Filed April 28th, 1869.

ASA WHITNEY *vs.* A. L. MOWRY. } 534.—In equity.

And now comes the defendant above named, A. L. Mowry, and moves the court to set aside the decree entered herein on the 5th day of April, 1867, and to grant a rehearing of said cause, and, as a ground of said motion, says that the complainant's said letters-patent, as extended, sued on herein, is null and void, for the reason that the extension thereof was procured by means of a gross fraud and deceit, practiced and perpetrated by said complainant upon the Commissioner of Patents.

That the defendant had no knowledge of such fraud, and had no means of knowing thereof until long after the entry of said decree, and long after the expiration of the term of court, when the same was entered.

And the defendant says that the fact of said fraud and deceit appears and is established by evidence taken herein since the entry of said decree and now on file herein, and consists in the fact that the complainant made a false and fraudulent statement, under oath, of the profits derived by him from his said letters-patent and invention during the original term for which the same was granted, whereby the said complainant

concealed from the said Commissioner of Patents the fact of the
776 receipt by the complainant of the sum of $237,494, as royalties for the use of his said patent, and of other large sums of money. And the said Commissioner of Patents, in granting and allowing said extension, was misled, defrauded, and deceived by the said false and fraudulent statement of the complainant.

A. L. MOWRY,
By CHA'S B. COLLIER,
His Solicitor.

777 U. S. cir. court S. dist. of Ohio.

Entry May 28, 1869.—*Journal O, p.* 170.

ASA WHITNEY
vs. } 534.
ALBERT L. MOWRY.

Upon the application of the master hereinbefore appointed, it is ordered that the complainant, at whose instance the order of reference was made, advance to the master, on account of his fees, the sum of one thousand dollars, within ten days from the entry of this order, and thereupon stand credited therewith, the same to be recovered by complainant from the defendant, if, upon the final disposition of this cause, the costs of the master be taxed to the defendant.

U. S. cir. court S. dist. of Ohio.

Entry October 7, 1869.—*Journal O, p.* 243.

ASA WHITNEY
vs. } 534.
ALBERT L. MOWRY.

Upon the application of the master hereinbefore appointed, it is ordered that the complainant, at whose instance the order of
778 reference was made, advance to the master, on account of his fees, the sum of two thousand two hundred and five dollars and ninety cents, ($2,205 90,) within ten days from the entry of this order, and thereupon stand credited therewith, the same to be recovered by complainant from defendant, if, upon the final disposition of this cause, the costs of the master be taxed to the defendant.

U. S. cir. court S. dist. of Ohio.

Entry November 9, 1869.—*Journal O, p.* 269.

ASA WHITNEY
vs. } 534.
ALBERT L. MOWRY.

The order made herein, on the 7th of October, 1869, is hereby modified so as to read as follows: It is ordered that the complainant, at whose instance the order of reference was made, advance to the master, on account of his fees, the sum of one thousand two hundred and five $\frac{90}{100}$ dollars, ($1,205 90,) within ten days from the entry of this order,

779 and thereupon stand credited therewith, the same to be recovered by the complainant from the defendant, if, upon the final disposition of the cause, the costs of the master be taxed to the defendant. The order made October 7th, and above referred to, is rescinded, and the remaining fees of the master left to the action of the court hereafter.

U. S. cir. court south. dist. of Ohio.

Entry December 16th, 1869.—Journal O, p. 318.

ASA WHITNEY
vs. } 534.
ALBERT L. MOWRY.

On motion to the court by counsel for the defendant, it is by the court here ordered that the special master in this cause, George R. Sage, esq., do forthwith, after the service upon him of a duly certified copy of this order, return to and file with the clerk of this court the original (manuscript) computation and calculations by which the profits of the defendant, as reported, are arrived at, the same being those computations referred to in the first finding of the original report of said master made herein; and it is further ordered that, if the said master shall be,
780 for any reason, unable to comply with the above order, he shall forthwith, after the service upon him of a copy hereof, state in writing to the court his reasons for non-compliance herewith. The clerk of this court is hereby directed to cause a duly-certified copy of this order to be served upon the special master.

And afterwards, to wit, but on the same day, and in the year last aforesaid there was issued out of the clerk's office of said court a duly certified copy of the foregoing order and same delivered to the marshal for service, and which is in the words and figures following, to wit:

Circuit court of the United States, southern district of Ohio. In equity.

ASA WHITNEY
vs. } 534.
A. L. MOWRY.

On motion to the court by counsel for the defendant, it is hereby ordered by the court that the special master in this cause, Geo. R.
781 Sage, esq., do forthwith, after the service upon him of a duly certified copy of this order, return to and file with the clerk of this court the original (manuscript) computation and calculations by which the profits of the defendant, as reported, are arrived at, the same being those computations referred to in the first finding of the original report of said master, made herein; and it is further ordered that, if the said master shall be, for any reason, unable to comply with the above order, he shall forthwith, after the service upon him of a copy hereof, state in writing to the court his reasons for such non-compliance herewith. The clerk of this court is hereby directed to cause a duly-certified copy of this order to be served upon the special master.

THE UNITED STATES OF AMERICA,
Southern District of Ohio, ss:

I, John McLean, clerk of the circuit court of the United States within

and for said district, hereby certify the foregoing order to be a true and correct copy of the original thereof, as the same remains on file
782 in this office for entry upon the journal of said court.

In testimony whereof I have hereunto set my hand and affixed the seal of said court, at Cincinnati, this 16th day of December, A. D. 1869, and in the 94th year of American independence.

Attest:
[SEAL.] JOHN McLEAN, *Clk.*

And afterwards, to wit, but on the same day, and in the year last aforesaid, came the marshal, to whom said order was in form aforesaid directed, and returned the same into the clerk's office of said court, with his proceedings endorsed thereon in the words and figures following, to wit:

CINCINNATI, *Dec.* 16*th*, 1869.

Received this writ Dec'r 16th, '69, at 9 a. m., and served the within-named Geo. R. Sage personally by copy this day.

A. HICKENLOOPER, *U. S. M.*,
By C. T. VAN SICKLEN, *Deputy.*

783 And afterwards, to wit, but on the same day and in the year last aforesaid, came George R. Sage, esq., and filed in the clerk's office of said court, his report in reply to order of court served on him Dec. 16, '69, which said report is in the words and figures following, to wit:

Circuit court of the United States, southern district of Ohio. In equity.

ASA WHITNEY
vs. } 534.
A. L. MOWRY.

The special master, in compliance with an order this day served upon him, herewith files all the original manuscripts of computations of profits referred to, which he has preserved. The printed tables and findings which are on file with the master's report, were each one by him compared, item by item, with the manuscript, and found to be in every particular correct. The printed tables were filed with the report for the sake of convenience, having been so verified & adapted
784 by the master. The comparisons & verifications were made by the master, with the assistance of his law partner, Thornton M. Hinkle, esq., in whose handwriting are those portions of the computations herewith submitted, which were not written by the special master. Every paper writing, which was filed with the master as evidence, was filed by him with the papers and documents accompanying his report as aforesaid.

All of which is respectfully submitted.

GEORGE R. SAGE,
Special Master.

CINCINNATI, *December* 16, '69.

U. S. circuit court, south. dis. of Ohio.

Decree.—Entered Oct'r 4, 1870.—(Journal O, p. 518.)

ASA WHITNEY
vs. } 534.
ALBERT L. MOWRY.

This cause having been heard upon the exceptions to the original and supplemental reports of George R. Sage, esquire, the special
785 master appointed herein, and having been argued by counsel for the respective parties, at the last term of this court; thereupon, and upon consideration thereof, it is ordered, adjudged, and decreed as follows, to wit:

First. That of the complainant's several exceptions to said reports, the second and third exceptions to the second (II) finding of the said supplemental report, dated March 23, 1869, be, and the same are hereby, sustained.

Second. That the other several exceptions of the complainant to said reports, be, and the same are hereby, overruled.

Third. That the several exceptions of the said defendant to said reports, be, and the same are hereby, overruled.

Fourth. That the second (II) finding of the said master's report in this case, dated March 23rd, 1869, be, and the same is hereby, overruled.

Fifth. That the said master's reports in this case, excepting said second (II) finding be, and the same are hereby, confirmed.

Sixth. That the profits made by the said defendant, in violation of the rights secured to the said complainant by the letters-patent No. 5531, granted to him April 25th, 1848, and extended for seven years from the 25th of April, 1862, in this case amounted to ninety-one thousand five hundred and one dollars and eighty-six cents, ($91,501 86.)

786 Seventh. That the said defendant do pay to the said complainant, within ten days from the entering of this decree, the sum of ninety-one thousand five hundred and one dollars and eighty-six cents, ($91,501 86,) and the further sum of nineteen thousand nine hundred and eighty-four dollars and twenty-one cents, ($19,984 21,) being interest on said principal sum to the first day of August, A. D. 1868, and the further sum of ten thousand nine hundred and eighty dollars and twenty-two cents, ($10,980 22,) being interest on said principal sum from August 1st, 1868, to August 1st, 1870, and the costs in this case to be taxed at $, with interest from the first day of August, 1870, on the aggregate of said several sums other than costs, and in default of the payment of said sums as aforesaid, or of any part thereof that execution issue therefor as in cases at law.

And now, from the said foregoing decree, the defendant prays an allowance of an appeal to the Supreme Court of the United States, which is hereby allowed.

787 U. S. circuit court, southern district of Ohio. In equity.

ASA WHITNEY
vs. } 534.
ALBERT L. MOWRY

And now comes the defendant above named, Albert L. Mowry, and

moves the court to vacate the interlocutory decree entered herein on the 5th day of April, 1867, and to allow the defendant to amend and correct his answer heretofore filed herein, and set up, by way of amendment, the fraud of the complainant, as hereinafter set forth, in the procuration by him of the extension of his letters-patent sued on herein, and the invalidity of such letters-patent, as extended by reason of such fraud, and to grant a rehearing of the said cause.

And the defendant states, in support of said motion, that the said complainant did not comply with the act of Congress regulating proceedings in matters of extension of letters-patent, by filing a true account of profit and loss; but procured the extension of his said letters-patent by means of a gross fraud and deceit practiced by him, the complainant, on the Commissioner of Patents, and that the said letters-patent
788 sued on herein are consequently null and void.

And the defendant states that the fraud of the complainant consisted in the fact that, being required by the act of Congress in force at the time of his said application for an extension to furnish to the Commissioner of Patents "A statement in writing, under oath, of the ascertained value of the invention, and of his receipts and expenditures sufficiently in detail to exhibit a true and faithful account of loss and profit in any manner accruing to him from and by reason of said invention," he, the said complainant, did furnish to said Commissioner of Patents, in connection with his said application for extension, a statement in writing duly signed and sworn to by him, said Whitney, on the 4th day of February, 1862, which purported to be a true and faithful account of loss and profit in any manner accruing to him, said Whitney, from and by reason of said invention.

I. But the defendant represents that the said account was not such true and faithful account as required by the said act of Congress, and as it purported to be; but that the same was, on the contrary,
789 untrue, false, and fraudulent, whereby the said complainant willfully and fraudulently concealed and suppressed from the Commissioner of Patents the fact of the receipt by him, the said Whitney, of the sum of $237,494 as royalties or license fee, for the use of his said patent and invention.

II. The said statement of account of profit and loss was also false and fraudulent, in that said Whitney suppressed and concealed therefrom other large sums of money exceeding $100,000, which sums he claims were paid to and received by him, said Whitney, during the original term of his said letters-patent, and prior to the furnishing by him of the said account to the said Commissioner of Patents, as an increased price and profit accruing to and received by him, said Whitney, on account of his said invention, in the manufacture and sale of wheels under said patent during the original term thereof.

And the defendant states that, the said Commissioner of Patents, in granting the said extension, was misled, defrauded, and deceived
790 by the said false and fraudulent statement of profit and loss of the said Whitney, and that, but for such fraudulent concealment and statement of account, no extension of said letters-patent would have been granted, as the defendant believes.

And the defendant states that he did not know, and had not the means of knowing, either at the time of filing his original answer herein, or at the time of the granting of the said interlocutory decree herein, nor until long after the enrollment of said decree, and the expiration of the term of the court at which the same was enrolled, of such fraud on the part of the complainant as aforesaid; that the facts con-

stituting such fraud were peculiarly within the knowledge of the said complainant, and not accessible to the defendant, and have been developed in the progress of this cause since the enrollment of the said interlocutory decree, and during the investigation of the questions referred to the special master, under the orders of the court here-
791 tofore entered herein; that when the original answer was filed, the defendant, then having no knowledge or notice of the fraud and falsehood in said account, nor of the deceit, suppression, and concealment of profits practiced by said Whitney in procuring said extension, did not dispute the validity of said extension, but was misled and deceived by the false and fraudulent statement of said Whitney (filed in the Patent Office) into the belief that said extension was fairly and honestly procured, and that said letters-patent were duly extended according to law; and the answer of the defendant was originally made in accordance with such belief, and in ignorance of the true facts, and of the fraud and concealment practiced by said complainant in his account of profit and loss aforesaid.

And, further, the defendant states that the fraud of the said complainant is made to appear, and is established by evidence taken and used before the special master, and reported to the court by him and filed herein, to which the defendant craves leave to refer at the
792 hearing hereof.

And, further, the defendant saith that, as soon as practicable after the first intimation had by him of the said fraud, and for the purpose of bringing the same to the knowledge of the court, and of availing himself thereof, he, defendant, through his counsel, did make diligent inquiry and examination at the Patent Office for said account of said Whitney, filed on the application for his said extension, and did seek to obtain a copy thereof; but that the same, as affiant is informed and believes, could not be found, and there was no copy thereof on record or on file, and affiant was not able to procure a copy thereof until about the month of December, A. D. 1868. And the defendant states that he has used due diligence in bringing said matter to the attention of the court, and presenting this, his motion.

And for the reasons aforesaid this motion to set aside the said interlocutory decree, and for leave to amend the answer of the defendant, &c., is now made.

793 A. L. MOWRY,
By EDWIN M. STANTON AND
CHA'S B. COLLIER,
His Counsel.

U. S. circuit court, southern district of Ohio.—In equity.

ASA WHITNEY
vs. } 534.
ALBERT L. MOWRY.

Affidavit.

THE STATE OF NEW YORK,
City of New York, ss:

Albert L. Mowry, the defendant above named, being duly sworn, deposeth and saith that the complainant above named, Asa Whitney, in the matter of the application by him for an extension of his letters-patent sued on herein, committed a fraud and deceit on the Commis-

sioner of Patents, by reason of which the said letters-patent, as extended, as affiant is informed and believed, are null and void; and affiant states—

794 I. That the said Whitney, being required by the act of Congress in force at the time of his application for such extension regulating such proceedings, to furnish to the Commissioner of Patents "A statement in writing, under oath, of the ascertained value of the said invention, and of his receipts and expenditures, sufficiently in detail to exhibit a true and faithful account of loss and profit in any manner accruing to him from and by reason of said invention, did furnish to the said Commissioner of Patents, in connection with his said application for extension, a statement in writing, duly signed and sworn to by him, said Whitney, which purported to be a true and faithful account of loss and profit in any manner accruing to him, said Whitney, from and by reason of said invention.

That in said sworn statement and account of loss and profit of said Whitney it was represented and set forth as follows, to wit:

"PROFITS.

"I believe there is no essential difference in the cost per pound of making cast-iron chilled car wheels of the various patterns, and
795 by the different modes in use, providing the same skill and system control the manufacture.

"But by my process I am enabled to make them lighter than those made in any other way for a similar service, and I can, therefore, afford to sell them at the same price per wheel as other makers, and save the cost of the difference in weight. This saving of metal, therefore, I deem to measure the essential advantage I have over my competitors, and also the profits arising from my patent, There have been made to January 1st, 1862, under my patent, 255,640 wheels of all sizes.

"From the best data I have been able to get upon the subject, I estimate that ten pounds per wheel would be a fair average of the metal saved by my process. On the larger sizes there is greater difference than this; but on the small sizes less.

"I therefore deem ten pounds per wheel as an average difference of weight between my wheels and those of other makers.

"The total amount of metal saved in all the wheels made, as
796 before stated, to January 1st, 1862, would, therefore, be 2,556,400 pounds, and the cost of the same at the average price paid for pig iron, say 1½ cents per pound, amounts to $38,346; while to develop and perfect my annealing process has cost, as per statement marked A, $52,970 31.

"The fourth set of annealing chambers, erected in 1857, were the first that have in all respects answered the purpose for which they were constructed; although the third set were a decided improvement on their predecessors, and the character of our wheels had been so much improved thereby, that the demand for them reached the highest point in 1856. Yet there was more expense and inconvenience in attending them than in the fourth set; so that, at most, it was only from 1856 that I have really begun to derive any material advantage from my process of annealing; and the profits that would otherwise have resulted from it since have been very much less than they would have been but for the two disastrous checks to the general business of
797 the country that occurred in 1857, and again in 1861.

"The cost of experiments and changes of structures for developing

the improvement patented has exceeded the profits, as before stated thus:

"Say, expenses	$52,970 31
"Profits	38,346 05
"Deficiat	$14,624 31

"STATE OF PENNSYLVANIA,
"*City and County of Philadelphia, ss:*

"Asa Whitney, being duly sworn, doth depose and say that the annexed statement and account is correct.

(Signed) "A. WHITNEY.

"Sworn and subscribed before me this fourth day of February, A. D. 1862.

(Signed) "CHA'S E. PANCOAST,
"*Alderman.*"

And affiant states that the said statement and account of the said Whitney was not a true and faithful account, as required by the said act of Congress; that it did not truly and correctly set forth and
798 disclose all of the profits and gains which had accrued to him, said Whitney, from and by reason of said invention, but that, on the contrary, the same was false and fraudulent; that, prior to the furnishing of said account, and during the original term of the said patent, to wit, in the year 1850, the said Whitney did execute a sale or license to the firm of A. Whitney & Sons, of the city of Philadelphia, for the use by them of his said patent, he, the said Whitney, as a consideration for such sale or license, to be paid the sum of one dollar a wheel, in addition to his proportion of the profits of the business of said firm, for all wheels manufactured and sold by said firm under said sale or license; and that said firm, from the year 1850 to the year 1861, both inclusive, manufactured and sold under said sale or license 237,494 wheels, for which the said Whitney now admits and testifies he was paid the sum of one dollar per wheel, amounting to the sum of $237,494; and he, the said Whitney, being a member of said firm, and having, as affiant is informed and believes, at the time of said sale or license, two-thirds interest therein, received to his own sole use and enjoyment as
799 such patentee, and as gain and profit from his said invention, under the said sale or license, and as payments from the said firm, during the said time and prior to said application for extension, a sum amounting to more than $79,000; that said sum ought to have been included in his account of profits so furnished to the said Commissioner of Patents, but affiant states that no part thereof was so included, nor was the fact of the receipt of such profits in any manner made known to the said Commissioner; but said Whitney falsely and fraudulently, and for the purpose of inducing the said Commissioner to believe that he, said Whitney, had not been sufficiently rewarded for his said invention, concealed the fact of such profits, and withheld the same from his said statement and account.

And the affiant states that the said letters-patent ought not to have been extended, and, as affiant is informed and believes, would not have been extended but for the fraudulent concealment of said Whitney as aforesaid; and that the said Commissioner of Patents was mis-
800 led, defrauded, and deceived by the said Whitney, and granted

and allowed the said extension on the supposed truth of the said account, and under the belief that said Whitney had not been sufficiently remunerated for his said invention, and had lost money thereby, whereas, in fact and in truth, the said Whitney had been fully and adequately remunerated therefor.

And affiant states that he has caused diligent search to be made at the Patent Office, in the proper books kept for the purpose, to ascertain whether any license or bill of sale has been recorded from said Whitney to said firm, and is informed and believes that there is no such instrument on record.

And further, affiant states that neither at the time of filing his answer herein, nor at the time of the granting of the said interlocutory decree, nor until long after the enrollment of said decree did he, affiant, have any suspicion of the fraud of said Whitney as aforesaid, or otherwise, as hereinafter referred to; that he had no actual or constructive knowledge of the existence of such license or sale, or the pay-
801 ment to, or receipt by, the said Whitney of said fees, and of the other gains as hereinafter referred to, but had good reason to believe, and did believe, the contrary thereof, and that no such license or sale had ever been granted, or such profits and gains derived by the said Whitney, or that the said account of profit and loss of the said Whitney was in any respect untrue or fraudulent.

And affiant states that he was misled and deceived by the sworn statements in this behalf in the bill of complaint, and of the affidavit of the complainant filed in connection with the said bill of complaint, (hereto attached and made part hereof, as hereinafter mentioned,) and believes that the averments in the said bill and affidavit to the effect that the complainant had maintained the exclusive monopoly of his said patent, and had refused to grant licenses thereof, excepting one in 1849, and one in 1851, which were soon thereafter revoked, as stated in said affidavit, were intended and designed by the complainant to mislead, as in fact they did, the defendant.

And affiant further says that when his original answer was filed herein, he then having no knowledge or means of knowledge, or
802 notice of the fraud and falsehood in said account, nor of the deceit, suppression, and concealment of profits practiced by said Whitney in procuring said extension, and being misled and deceived by the false affidavits of the said Whitney, did not dispute the validity of said extension; and the answer of the defendant was made under the belief, induced as aforesaid, that said extension was fairly and honestly procured, and in accordance with law.

And further, affiant says that the fact of the fraud and concealment of the said Whitney as aforesaid, and as hereinafter referred to, was not only unknown to affiant at the time of the filing of his said answer, and until the same was developed in the proceedings before the special master herein, but that the same rested peculiarly within the knowledge of the said Whitney, and was not accessible to, and could not have been, by reasonable diligence or inquiry, ascertained or discovered by the defendant prior to such proceedings before the said special master.

And further, affiant saith that he has used all proper diligence, as he believes, in bringing the fact of the said fraud to the knowledge and attention of the court.

803 II. And further, affiant states that said account of profit and loss was also false and fraudulent in the following particular, to wit, that in the said application of said Whitney for extension he represented to said Commissioner of Patents that his only source of profit

under his said patent had been in a saving of metal, amounting to the sum of $38,346 on 255,494 wheels made by him, to the time of the making of said account; that, on the contrary, since the enrollment of the said decree, he, said Whitney, being examined as a witness in his own behalf in the proceedings before the special master, testified that the wheels made by him as aforesaid sold more readily than those of other manufacture, and at an enhanced profit, by reason of his said patented invention, of at least one dollar per wheel more than such other wheels; and affiant says that, by the statement last aforesaid of said Whitney, he, said Whitney, did realize a further profit on the said 255,494 wheels made and sold by the said firm of A. Whitney & Sons prior to the making of said application for extension, and to the said account of loss and profit of said Whitney, amounting to a net sum not less than $100,000.

804 And your affiant alleges that such sum, if so received as now testified to by said Whitney, should have been included in his account of profits to the said Commissioner of Patents, but that the same was not, nor was any part thereof so included.

And affiant annexes hereto, as exhibits to this his affidavit, true and correct copies of the bill of complaint of the complainant, and his affidavit in support of the motion made by him for a preliminary injunction, marked A and B, respectively, of the testimony of the said complainant taken on the 27th day of August, A. D. 1867, and again December, 1868, marked C, and of the statement and account of loss and profit, and of the argument of the said Whitney in the matter of his said application for extension, and of the report of the examiner and Commissioner of Patents on such application, marked D, and of the certificate of the Commissioner of Patents as to assignments and other instruments of writing on record in the Patent Office, granted by said Whitney under said patent.

And further affiant saith not.

(Signed) A. L. MOWRY.

805 Sworn and subscribed before me and in my presence on this 11th day of October, 1869.

(Signed) R. E. STILWELL,

U. S. Commissioner for the Southern District of New York.

U. S. circuit, south. dist. of Ohio.

Entry.—October 24, 1870.—*Journal O, p.* 518.

ASA WHITNEY. *vs.* ALBERT L. MOWRY. } 534.

This cause having been heard at the last term of the court upon the motion submitted by the defendant to vacate the interlocutory decree of April 5, 1867, and for leave to amend his answer by setting up that the extension of the patent in the bill of complaint set forth was obtained by the complainant by means of fraud and perjury, and the same having been argued by counsel for the respective parties, and having been duly considered by the court, it is thereupon hereby ordered, adjudged, and decreed that the said motion be, and the same is hereby, overruled. To which order as above the said defendant prays an appeal to the Supreme Court of the United States, which is allowed.

806 United States circuit court, southern district of Ohio. In equity.

ASA WHITNEY
vs. } 534.
ALBERT L. MOWRY.

Appeal bond.

Know all men by these presents that we, Albert L. Mowry, of the city of New York, as principal, and Noyes G. Green, of Cincinnati, Ohio, as surety, are held and firmly bound unto Asa Whitney, in the sum of one hundred and fifty thousand dollars, to be paid to the said Asa Whitney, his executors, administrators, and assigns, for the payment of which well and truly to be made, we bind ourselves, our and each of our heirs, executors, and administrators, jointly and severally, firmly by these presents, sealed with our seals, and dated the 20th day of October, one thousand eight hundred and seventy: Whereas the above-named Albert L. Mowry has prosecuted an appeal to the Supreme Court of the United States out of this court, to reverse the judgment, and decree entered, at the city of Cincinnati, in the above-entitled suit, and entered with the clerk of this court on the 5th day of
807 April, 1867, by which decree it was adjudged that said defendant had infringed upon, and violated the letters-patent of said complainant mentioned in the bill of complaint herein, and directing a reference to ascertain the profits that said defendant had realized from such infringement, and that the defendant pay to the said complainant the amount ascertained to be due to him, and also to reverse the order of said court made herein on the 13th day of July, 1870, and entered October , 1870, confirming the report of the master to whom said cause was referred, founded on said decree, and directing that the defendant pay to said complainant the sum of one hundred and twenty-two thousand four hundred and sixty-six $\frac{29}{100}$ dollars besides the complainant's costs herein, to be taxed:

Now, therefore, the condition of this obligation is such that if the above-named Albert L. Mowry shall prosecute his said appeal to effect, and shall pay the several sums awarded by the said order and
808 decree and answer all damages and costs if the said decree shall be affirmed, then this obligation to be void; otherwise to be and remain in full force and virtue.

ALBERT L. MOWRY. [SEAL.]
NOYES G. GREEN. [SEAL.]

Signed, sealed, and delivered in presence of—
As to Albert L. Mowry.
WILLIAM W. HEATON.
CHA'S F. PEET.
As to Noyes G. Green.
RICHARD C. ROHNER.
TOM AMBROSE.

Filed October 20th, 1870.

Taken and acknowledged before me by the above-named Albert L. Mowry on the day hereinabove written.

(Signed) JOHN A. SHIELDS,
U. S. Commissioner S. D. of N. Y.

Taken and acknowledged before me by the above-named Noyes G. Green on this 24th day of October, A. D. 1870.

(Signed) JOHN McLEAN, *Clerk.*

The counsel for the complainant agreeing to the sufficiency of the foregoing bond, the same is hereby approved and accepted.

(Signed) H. H. LEAVITT,
One of the Judges of the said Circuit Court.

OCT. 24, 1870.

U. S. circuit court, south. dis. of Ohio.

Entry.—October 24, 1870.—*Journal O, p.* 519.

ASA WHITNEY
vs. } 534.
ALBERT L. MOWRY.

Upon the application of the master hereinbefore appointed, it is ordered that the complainant, at whose instance the order of reference was made, advance to the master on account of his fees, the sum
809 of one thousand dollars ($1,000) being, with what has heretofore been paid, the full amount thereof, within ten days from the entry of this order, and thereupon stand credited therewith, the same to be recovered by complainant from the defendant, if, upon the final disposition of this cause, the costs of the master aforesaid be taxed to the defendant.

U. S. circuit court, southern district of Ohio. In equity.

ASA WHITNEY
vs.
ALBERT L. MOWRY.

You will please take notice, that Albert L. Mowry, the defendant in the above-entitled cause, hereby appeals to the Supreme Court of the United States from the decree made and entered herein on the 5th day of April, A. D. 1867, declaring that the letters-patent recited in the bill of complaint in said cause were valid, and that the defendant had infringed the same, and directing that the defendant pay to the complainant the amount of profits made by him, the defendant, from said
810 infringement, and the costs of this suit, and the defendant further appeals from the final order and decree of this court, made and entered on the day of October, A. D. 1870, determining the amount of profits made by the said defendant from the said infringement, and directing the payment thereof to the said complainant, also, from the order and decree of the said court, overruling the motion of the said defendant to vacate the said decree of April 5th, 1867, and for leave to file a supplemental answer, &c.

CHA'S B. COLLIER,
Solicitor for Defendant.

To HENRY BALDWIN, Jr., Esq.,
Of Counsel for Complainant.

ASA WHITNEY
vs.
ALBERT L. MOWRY. } In equity.

To the honorable the Chief Justice and Associate Justices of the Supreme Court of the United States:

811 The petition of appeal of the above-named defendant, Albert L. Mowry, respectfully showeth:

That, on the day of , A. D. 1866, the above-named complainant, Asa Whitney, filed his bill of complaint against the above-named defendant in the circuit court of the United States for the sixth circuit and southern district of Ohio, alleging therein that he, the said complainant, was the original and first inventor of a new and useful "process for prolonging the time of cooling, in connection with annealing cast-iron railroad car wheels," for which, as alleged in said bill of complaint, letters-patent of the United States were granted to said complainant for fourteen years from and after the 25th day of April, A. D. 1848; that, afterwards, to wit, on the 7th day of April, A. D. 1862, upon application made therefor, the Commissioner of Patents did extend and renew the aforesaid letters-patent for the further term of seven years from and after the said 25th day of April, A. D. 1862; the said bill of complaint also alleging that the said defendant had been and was infringing the said letters-patent, to the damage and

812 injury of the complainant and to the profit of the defendant, and containing a prayer for a provisional and perpetual injunction, restraining the said defendant from practicing or using the process of annealing and prolonging the time of cooling cast-iron railroad car wheels, described and specified in the complainant's letters-patent aforesaid; and that the said defendant should also be decreed to account for, and pay to the complainant, the gains and profits received by him from practicing or using the said process so patented to said complainant, and the damage sustained by complainant by reason of the defendants' infringement thereof; and that the cast-iron railroad car wheels in possession or use of the defendant or his agents might be destroyed, or delivered up to the complainant for that purpose; and that the complainant should have such other and further relief as the equity of the case might require, and to the court might seem meet.

That your petitioner, the defendant in said cause, duly filed his answer to the said bill of complaint, denying the said alleged in-

813 fringement, and alleging the invalidity of said complainant's said letters-patent for want of novelty and utility; and the said complainant replied to said answer; and such proceedings were thereupon had in the said cause that, on the 5th day of April, A. D. 1867, a decree was entered therein by the said circuit court, in the words as follows, to wit:

"This suit having been brought to a final hearing upon the pleadings and proofs, and counsel for the parties respectively having been heard thereon, and the same having been duly considered by the court, it is found and hereby ordered, adjudged, and decreed, that the letters-patent on which the suit is brought, and which are referred to in the bill of complaint for an improvement in annealing and cooling cast-iron car wheels, granted by the United States to Asa Whitney, bearing date the 25th day of April, 1848, and the extension thereof, are good and valid; that the said Asa Whitney was the first and original inventor of the improvement thereby secured; that the said improvement is useful, and that the defendant, Albert L. Mowry, has infringed upon

814 said patent, and upon the exclusive right of the complainant under and by virtue of the same.

"And it is further ordered, adjudged, and decreed, that the complainant do recover of said defendant the profits, gains, and advantages which said defendant has received, or which have arisen or accrued to him from said infringement of said patent by the manufacture, use, or sale of cast-iron car wheels constructed in accordance with the improvement granted and secured by said patent; and, also, that said complainant recover of said defendant his costs, charges and disbursement in this suit to be taxed.

"And it is hereby further ordered, adjudged, and decreed, that it be referred to George R. Sage, esq., of Cincinnati, Ohio, who is hereby appointed as special master of this court for the purpose, to ascertain and take and state and report to the court an account of the gains, advantages, and profits which said defendant has received, or which have arisen or accrued to him, from infringing said patent by the manufacture, use, or sale of cast-iron car wheels made by the use of the improvement patented in and by said patent.

"And it is further ordered, adjudged, and decreed, that the
815 complainant, on such accounting, have the right to cause an examination of the defendant, ore tenus or otherwise, and also the production of his books, vouchers, and documents; and that said defendant attend for such purpose before said master, from time to time, all as said master shall direct.

"And it is hereby ordered, adjudged, and decreed, that a perpetual injunction be issued in this suit against the defendant, Albert L. Mowry, pursuant to, and in accordance with, the prayer of the bill of complaint filed in this cause."

Your petitioner further shows that, in pursuance of the said interlocutory decree, the said master, George R. Sage, esq., proceeded to take and state the account required thereby, and filed his report therein, bearing date the first day of August, A. D. 1868, and a supplemental report, dated the 17th day of September, A. D. 1868, to which said reports the counsel for the parties respectively filed exceptions; that said cause coming on to be heard upon the questions arising on said report, such proceedings were thereupon had that the court, on the 22d day of October, A. D. 1868, made an order in said cause in the words as follows, to wit:

816 ASA WHITNEY
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ALBERT L. MOWRY. } 534. In equity.

"This cause came on to be heard upon the reports of the master, and the exceptions thereto, and was argued by the counsel of the respective parties; whereupon it is ordered by the court that the said master take further testimony and report to the court what proportion, if any, of the profit made by the said defendant, was due to the use by him of the complainant's invention; and that in connection with this subject he report—

"First. Whether the wheels made and sold by the defendant had, or could have been made to have, any market value, without being subjected to the process patented to the complainant.

"Second. If they had, or could have been made to have, such value, by any annealing or slow-cooling process outside of the complainant's

patent, how much additional and greater market value, if any, they derived from being subjected to said patented process.

"It is further ordered that said testimony shall be taken within sixty days from the time of the entry of this order; that said master
817 shall file his report within forty days thereafter, and that either party may file exceptions within thirty days thereafter; and this cause is continued."

Your petitioner further shows that, in pursuance of said decretal order last aforesaid, the said special master did proceed to take testimony, and did, on the 23d day of March, A. D. 1869, file his final report in said cause, to which report exceptions were taken and filed by the counsel of the respective parties.

That, pending said proceedings before said master, the said defendant, with leave of court first had, did file and submit a motion to vacate said decree of April 5th, 1867, for certain alleged frauds on the part of said complainant, fully set forth in said motion, and for leave to set up said frauds by way of supplemental answer.

That, the cause coming on to be heard on the questions arising on said reports, and on said motion to vacate, &c., such proceedings were had that the said court on the 24th day of October, A. D. 1870, made and entered a final decree in said cause in the words and figures following, to wit:

818 U. S. circuit court, southern district of Ohio. In equity.

ASA WHITNEY *vs.* ALBERT L. MOWRY. } No. 534.

Final decree.

This cause having been heard upon the exceptions to the original and supplemental reports of George R. Sage, esq., the special master appointed herein, and having been argued by counsel for the respective parties at the last term of this court, thereupon, and upon consideration thereof, it is ordered, adjudged, and decreed as follows, to wit:

First. That of the complainant's several exceptions to said reports, the second and third exceptions to the second (II) finding of the said supplemental report, dated March 23d, 1869, be, and the same are hereby, sustained.

Second. That the other several exceptions of the complainant to said reports be, and the same are hereby, overruled.

Third. That the several exceptions of the said defendant to said reports be, and the same are hereby, overruled.

Fourth. That the second (II) finding of the said master's report in the case, dated March 23d, 1869, be, and the same is hereby, overruled.

819 Fifth. That the said master's reports in this case, excepting said second (II) finding be, and the same are, hereby confirmed.

Sixth. That the profits made by the said defendant, in violation of the rights secured to the said complainant by the letters-patent No. 5531, granted to him April 28th, 1848, and extended for seven years from the 25th of April, 1862, in this case, amount to ninety-one thousand five hundred and one dollars and eighty-six cents, ($91,501 86.)

Seventh. That the said defendant do pay to the said complainant, within ten days from the entering of this decree, the sum of ninety-one

thousand five hundred and one dollors and eighty-six cents, ($91,501 86,) and the further sum of nineteen thousand nine hundred and eighty-four dollars and twenty-one cents, ($19,984 21,) being interest on said principal sum to the 1st day of August, 1868; and the further sum of ten thousand nine hundred and eighty dollars and twenty-two cents, ($10,980 22,) being interest on said principal sum from August 1st, 1868, to the 1st day of August, 1870; and the costs in the case, to be
820 taxed , with interest from the 1st day of August, 1870, on the aggregate of said sums other than costs; and, in default of the payment of said sums as aforesaid, or any part thereof, that execution issue therefor, as in cases at law.

Enter the first Tuesday in August, 1870.

(Signed) N. H. SWAYNE.

And now from the said foregoing decree the defendant prays the allowance of an appeal to the Supreme Court of the United States, which is hereby allowed.

(Signed) N. H. SWAYNE.

U. S. circuit court, southern district of Ohio. In equity.

ASA WHITNEY
vs.
ALBERT L. MOWRY. } No. 534.

This cause having been heard at the last term of the court upon the motion submitted by the defendant for leave to vacate the interlocutory decree of April 5th, 1867, and amend his answer by setting up that the extension of the patent in the bill of complaint set forth was ob-
821 tained by the complainant by means of fraud and perjury; and, the same having been argued by counsel for the respective parties, and having been duly considered by the court, it is thereupon hereby ordered, adjudged, and decreed that the same is hereby overruled; to which order and decree, as above, the said defendant prays an appeal to the Supreme Court of the United States, which is allowed.

And your petitioner humbly represents that he is advised and believes that the said original interlocutory decree, dated and entered in said cause on the 5th day of April, A. D. 1867, and the said final decrees, entered on the said 24th day of October, A. D. 1870, were, and are, and each of them was, and is, erroneous, and ought to be reversed.

And the prayer of an appeal to the Supreme Court of the United States having been allowed to said defendant, he doth now and hereby humbly and respectfully pray that the said final and interlocutory decrees, and the said decretal order of the said circuit court of the
822 United States, together with the bill of complaint, answer, reply, depositions, evidence, and proofs taken and introduced before said special master, the several reports of said master and the exceptions thereto, and all proceedings had in said cause, may be sent to the Supreme Court of the United States without delay, and that the Supreme Court will proceed to hear the said cause anew, and that the said decrees of the circuit court may be reversed, and a decree made dismissing the said bill of complaint, with costs, or such other decree as to the said Supreme Court shall seem just.

CHA'S B. COLLIER,
Solicitor for Defendant.

Filed October 31st, A. D. 1870.

U. S. circuit court, south D. of O. In equity.

ASA WHITNEY
vs.
ALBERT L. MOWRY. } No. 534.

It is hereby agreed that the printed documents included in the package to which this is attached are true copies of the original documents in the above cause, of which they purport to be copies.

823

HENRY BALDWIN, JR.,
Sol'r for Compl't.
CHA'S B. COLLIER,
For Def't.

PHIL'A, *Nov.* 7, '70.

To JOHN MCLEAN, Esq.,
Cl'k U. S. Circuit Court Southern Dist. of Ohio.

Filed Nov. 11, 1870.

U. S. circuit court.

Motion.

ASA WHITNEY
vs.
ALBERT L. MOWRY. } 534.

And now comes the defendant above named, and moves the court to vacate and set aside the orders hereinbefore entered herein directing the payment of fees and costs to George R. Sage, esq., special master, to wit: Order of May 28, 1869, directing the payment to said master of $1,000 00 fees; order of Nov. 9, 1869, directing the payment of $1,205 90 fees; and order of Oct. 24, 1870, directing the payment of $1,000 00 fees.

824 And the defendant represents that the claim of said master is excessive and unreasonable, and should not be allowed.

Wherefore the defendant moves the court to vacate the said orders and allowances, and for a retaxation of said costs and fees.

A. L. MOWRY,
By CHA'S B. COLLIER,
His Solicitor.

CINCINNATI, *Nov.* 14, 1870.

Filed Nov. 14, 1870.

U. S. circuit court, S. dist. of Ohio. Chancery.

Entry, Nov'r 14, 1870.—*Journal O, p.* 537.

ASA WHITNEY
vs.
ALBERT L. MOWRY. } 534.

This cause coming on to be heard this day, on the motion of defend-

ant to vacate the orders heretofore entered herein directing the payment of fees to the special master, and for a retaxation of said master's fees, it is now and hereby ordered by the court that said motion stand continued until the final determination of this cause by the Supreme
825 Court of the United States, and that the amount of fees allowed said master be then determined as may be deemed proper; the object hereof being to leave said matter open, and subject to the revision of this court.

826 THE UNITED STATES OF AMERICA,
Southern District of Ohio, ss:

I, John McLean, clerk of the circuit court of the United States within and for said district, hereby certify the foregoing transcript to be truly taken and copied from the files and records of said court as the same remain in this office.

In testimony whereof I have hereunto set my hand and affixed the seal of said court, at Cincinnati, this 19th day of November, A. D. 1870, and in the 95th year of the independence of the United States of America.

Attest:

[SEAL.] JOHN McLEAN, *Clerk.*

(Indorsement on cover:) No. 349. Albert L. Mowry, appellant, vs. Asa Whitney. S. Ohio C. C. U. S. Filed 7th December, 1870.

ant to vacate the orders heretofore entered herein directing the payment of fees to the special master, and for a retaxation of said master's fees, it is now and hereby ordered by the court that said motion stand continued until the final determination of this cause by the Supreme
825 Court of the United States, and that the amount of fees allowed said master be then determined as may be deemed proper; the object hereof being to leave said matter open, and subject to the revision of this court.

826 THE UNITED STATES OF AMERICA,
Southern District of Ohio, ss:

I, John McLean, clerk of the circuit court of the United States within and for said district, hereby certify the foregoing transcript to be truly taken and copied from the files and records of said court as the same remain in this office.

In testimony whereof I have hereunto set my hand and affixed the seal of said court, at Cincinnati, this 19th day of November, A. D. 1870, and in the 95th year of the independence of the United States of America.

Attest:
[SEAL.] JOHN McLEAN, *Clerk.*

(Indorsement on cover:) No. 349. Albert L. Mowry, appellant, vs. Asa Whitney. S. Ohio C. C. U. S. Filed 7th December, 1870.

United States Supreme Court.

ALBERT L. MOWRY, *Appellant,*

vs.

ASA WHITNEY, *Appellee.*

IN EQUITY.

No. 148.

APPEAL FROM THE CIROUIT COURT OF THE UNITED STATES FOR THE SOUTHERN DISTRICT OF OHIO.

ASSIGNMENT OF ERRORS OF THE COURT, AND BRIEF OF POINTS ON BEHALF OF THE APPELLANT.

Butt & Co., Prs., 37 and 39 S. Third St., Phila.

Supreme Court of the United States.

Albert L. Mowry, Appellant,
vs.
Asa Whitney, Appellee.
} *In Equity.*

ON APPEAL FROM THE CIRCUIT COURT OF THE UNITED STATES, FOR THE SOUTHERN DISTRICT OF OHIO.

SUIT FOR INFRINGEMENT OF LETTERS PATENT NO. 5531, FOR "IMPROVEMENT IN ANNEALING AND COOLING CAST-IRON CAR WHEELS"—GRANTED APRIL 25, 1848. EXTENDED APRIL 25, 1862.

STATEMENT OF ERRORS OF THE CIRCUIT COURT ON WHICH THE INTERLOCUTORY AND FINAL DECREES WERE BASED.

First. The *argument* of the Court, by which the ultimate conclusion was reached, is incongruous, in this, to wit: that, in considering the question of *novelty*, Whitney's Patent is protected as against prior annealing processes by reason of such prior processes being confined, as stated by the Court (an error of fact), to "unchilled" articles, and Whitney's to "chilled" articles; whereas, in considering the question of *utility*, the Court held—"If it were conceded that the heat provided in the Patent was to *destroy the chill*, I should hesitate to pronounce the Patent invalid."

Second. The Court erred in construing Whitney's Patent, the error appearing in the concluding paragraph of that portion of the opinion now quoted, to wit:

"He, Whitney, avoids the point of incipient, or actual fusion, but *requires* the heat to be a *little* below that point." * * *

"It is not supposable that the inventor intended what would destroy the very object he had in view, namely: to make a wheel *in which the chill of the periphery should be preserved*, and the inherent strain from unequal contraction avoided. I am clear that the Patent may be regarded as claiming, by the fair import of the words, "a little below the point of fusion," *such a degree of heat as is necessary to effectuate the intention of the inventor.*"

In considering the question of *construction*, under the above proposition, the following authorities will be referred to:

Curtis on Patents, (Edition of 1867), Sec's 227, 228, 229.
Evans vs. *Eaton*, 7 Wheaton, 356.
U. S. Patent Laws, Act of 1836, Sec. 6.
Derosne vs. *Farie et al.*, Webster's Patent Cases, 165.
Morgan et al., vs. *Seward et al.*, " " 174.

Third. The Court erred in deciding the issues of *novelty*, *utility* and *infringement* in favor of the Complainant—appellee—such decision being based, not only on errors of law, but being also contrary to the weight of the evidence.

Fourth. The Court erred in decreeing "that the profits made by the said Defendant, in violation of the rights secured to said Complainant by the Letters Patent, No. 5531, granted to him April 25, 1848, and extended for seven years, from the 25th of April, 1862, in this case amounted to $91,501 86:"—because:

A. Upon the hypothesis that the sum stated was derived by said Defendant—appellant—from the manufacture and sale of the wheels embraced in the account of the Master, no part thereof was derived by reason of such "infringement."

B. The said sum does not correctly represent, but on the contrary is an over statement of the profits derived by the appellant from the manufacture and sale of the wheels from which said sum purports to have been derived.

Fifth. The Court erred in decreeing "that the said Defendant—appellant—do pay to the said Complainant—appellee—within ten days from the entering of this decree, the sum of $91,501 86, and the further sum of $19,984 21, being interest on said principal sum to the first day of August, 1868, and the further sum of $10,980 22, being interest on said principal sum from August 1st, 1868, to August 1st, 1870, and the costs in this case to be taxed at $, with interest from the first day of August, 1870, on the aggregate of said several sums other than costs," &c.—because :—

A. The *rule* or *principle* on which said principal sum is decreed, as adopted by the Court, was based on errors of law.

B. Upon the hypothesis that the rule or principle of law as adopted by the Court was correct as to said principal sum, then:

C. The allowance of *interest* was erroneous, because, *first*, of errors in the computations of the Master in arriving at said principal sum. *Second.* Because the principal sum being erroneously stated by the Master, the computation of interest is also erroneous. *Third.* Because the Complainant—appellee—was not entitled to recover interest, which may have accrued on any sum prior to the final decree.

Sixth. The Court erred in over-ruling the exceptions of the Counsel for Defendant—appellant—to the findings and reports of the Master.

Seventh. The decision of the Court was not in accordance with the rules and principles of equity.

Eighth. The decision and decree of the Court is at variance with the reports of the Master which it confirms.

BRIEF OF POINTS SUBMITTED ON BEHALF OF THE APPELLANT—MOWRY—HAVING REFERENCE TO THE QUESTIONS PRESENTED TO THE COURT AT THE ORIGINAL HEARING OF THE CAUSE.

1. Whitney's Patent is invalid for want of novelty, his process being, at most, simply the application of a well-known process to a purpose analagous to those purposes to which, long anterior to his alleged invention, it had been applied.

In support of this proposition the following authorities will be referred to:

Curtis on Patents (Edition of 1867), Sec's 53–56.
Howe vs. *Abbott*, 2 Story's Rep., 190.
Winans vs. *Boston & Prov. R. R.*, 2 Story, 412.

2. Whitney's Patent is void because that which is described and claimed therein is not useful, inasmuch as such process would destroy the hardness of the rim, (known as the "chill") of the wheels, and thus greatly detract from the usefulness and durability of the wheels.

As collateral or subordinate propositions to the last, the following points are submitted:

A. That a "chilled" periphery, or tread, is an essential feature to a useful car wheel.

B. That Whitney's Patent designates and provides for such degree of re-heating, and none other ("*a little below that at which fusion commences*") as will destroy the "chill."

3. The process, as conducted by the Defendant—appellant—Mowry, did not infringe the Patent of Whitney.

POINTS HAVING REFERENCE TO THE QUESTIONS ARISING ON THE MASTER'S REPORTS, AND TO THE QUESTION OF DAMAGES, OR AMOUNT OF RECOVERY.

I. The measure of recovery—whether Complainant's *damages* or Defendant's *profits* be made the standard—

is not the same when the invention, or Patent, covers an *improvement* on a machine, or process, as where it covers the *entire* machine or process.

Seymour vs. *McCormick*, 16 Howard, 480.
McCormick vs. *Seymour*, 3 Blatchf., 211; 19 Howard, 96.
Burdell vs. *Denig*, 2 Fisher's Pat. Cases, 595–597.
Sewell vs. *Collins*, 1 " " " 297.
The Suffolk Co. vs. *Hayden*, 3 Wallace, p. 315.
Bell vs. *McCullough*, 1 Fisher, 379.
Whitney vs. *Mowry* (Record of this cause, p. 272).

II. When the Patent is for an *improvement* only, whether its subject-matter be a *machine* or a *process*, the recovery is measured by the increased value given to the machine, or process, by the "improvement" which is engrafted upon it.

[Same authorities as above.]

III. The manufacture of a cast-iron car wheel is a succession of processes consisting of, *First*, the mixing of the iron, having reference to the proper proportion of iron possessing the property of receiving a "chill." *Second*, the melting, stirring and *pouring of the metal*, having reference to the duration of the operation and the *temperature* of the metal when poured. *Third*, the formation of the wheel, having reference, both to the *configuration* of the wheel, and the character of the *mould* in which it is cast, the same being composed in part of iron and in part of sand. *Fourth*, the removal of the wheel from the mould, having reference to temperature. *Fifth*, the prolongation of the cooling of the wheel, having reference to uniformity of contraction and proper adjustment of its particles, so as to prevent

inherent strains, and secure, as nearly as possible, the ultimate strength of the casting.

Each one of the foregoing enumerated processes, or steps, is of importance in the manufacture of a car wheel, and each one is so far independent of the others as that it might be the subject-matter of Letters Patent.

[See Lobdell's testimony, record, p. 316, Quest. 3.]

IV. Whitney's invention and Patent does not cover, either the entire manufacturing arts or processes by which the perfected product is produced, or the product itself as a new article of manufacture; but embraces only an "*improvement*" in *one* of the several processes entering into the fabrication or manufacture of the article.

V. Such "improvement" consists in "prolonging the time of cooling in connection (*combination*) with *annealing*" (re-heating); there being no claim for either element of the combination separately.

["The re-heating is that which is claimed to be new, and which this Court has found, heretofore, to be new: this combination of the re-heating with the old thing, the slow-cooling of the wheel."]

[Opinion in this cause Oct., 1868, record, p. 272.]

VI. Annealing by *slow-cooling* attains every end desirable; by it a cast-iron chilled car wheel of any form or configuration, *straight-plate, single-plate, double-plate, double and single plate combined, solid-hub*, can be made, and such are manufactured to a vast extent (Lobdell alone making 30,000 to 40,000 per year), and *costing less* than the re-heated wheel (by the difference of cost of fuel); *they sell for as much, or more* (as Whitney himself testifies) than the re-heated wheel.

VII. Whitney *disclaims* on the face of his Patent the "ordinary" method of annealing; the testimony shows that annealing, by *slow-cooling*, of car wheels was not invented or first practised by Whitney.

Mowry, for ten years, as the record shows, prior to 1861, slow-cooled his car wheels.

His infringement *began* when he added re-heating to slow-cooling, and *ended* when he ceased to re-heat, and resumed slow-cooling.

The use of the *re-heating* element determining the *fact* of infringement, the inquiry is, what proportion of Mowry's aggregate profit was due to, or derived from, the use of such element.

Seymour vs. *McCormick*, 16 Howard, 480.
Burdell vs. *Denig*, 2 Fisher's Pat. Cases, 595.
Whitney vs. *Mowry*, Record of this cause, p. 272.

VIII. Mowry's manufacture, aside from all that belonged to the public, was, as the record shows, conducted under the protection of Letters Patent as follows, to wit: Atwood's, granted May 15, 1847 (one year earlier than Whitney's), which was duly extended: Murphy's, granted Aug. 7, 1849, extended for seven years, from Aug. 7, 1863: Washburn's, granted Oct. 8, 1850: Mowry's, granted May 7, 1861.

The determination, and award of "profits," therefore, should be restricted to the value of Whitney's "improvement," in connection with the value of the other patented improvements; and the total profits of Mowry during the period of infringement being ascertained, an *apportionment* thereof should be made upon the principle stated above.

[Same authorities as before cited.]

IX. In apportioning "profits" reference must be had to the value of the invention as *patented*, and not as subsequently improved upon; and Whitney's process, as described and claimed in his Patent, could not be employed, profitably, by any person.

[Shown by Whitney's sworn Extension Statement and Account, Record, p. 370, and other testimony.]

X. Whitney, to entitle himself to a recovery of more than *nominal damages*, assuming infringement, must prove, either that he has been damaged, lost money by the infringement, or that Mowry has gained money thereby; he proves *neither*.

1. He does not show, or attempt to show, that he ever lost the sale of a wheel by reason of Mowry's infringement.

2. He does, on the contrary, testify affirmatively (see his deposition of Dec., 1868, record, p. 335, +Quest. 50), that his only competitor has been Lobdell, of Wilmington.

XI. Did Mowry gain anything by reason of the infringement?

His infringement began, as stated, when he began to re-heat, and *ended* when he ceased to re-heat; he had the right to *slow-cool*; the inquiry is, therefore, did hega in anything by the *re-heating*?

To this inquiry there can be but one answer; it is conclusively established, that whatever profit Mowry may have made in his *business*, he lost money by reason of the *re-heating* by just so much as was the cost of the *fuel* and the additional labor—reported by the Master to be twenty-five cents per wheel—making a total loss on the 19,819 wheels, of $4,954 75.

In other words, that the profits of his business would have been greater by that amount, if he had not used charcoal, and continued simply to slow-cool in the manner as practised by him prior to the employment of charcoal.

[Shown by findings and reports of the Master, which are confirmed by the Court.]

XII. Whitney having proved no *loss*, and Mowry having made no *gain*, the infringement was *damnum absque injuria*, and in no event is Whitney entitled to a decree for more than nominal damages.

XIII. The estimate of the profits of Mowry's business, as made for, and adopted and reported by the Master, is not reliable—is inconsistent in its several parts, and with the testimony, and is calculated to mislead and deceive.

XIV. In computing damages, or profits, interest is not to be allowed, except from date of decree.

***Silsby* vs. *Foote*, 20 How., 378.**
***LeRoy* vs. *Tatham*, 22 How., 378.**

XV. Whitney is estopped by his own sworn statement from attributing any value to his "improvement," or asserting any profits to have been derived thereby, other than a *saving of metal* of ten pounds per wheel, amounting on the 19,819 wheels made by Mowry to $5,450 21.

"This saving of metal, therefore (10 pounds per wheel), I deem to measure the essential advantage I have over my competitors, and also the profits arising from my Patent."

[Whitney's Extension Statement, record, p. 373.]

CHAS. B. COLLIER,
OF COUNSEL FOR
ALBERT L. MOWRY,
Appellant.

United States Supreme Court.

ALBERT L. MOWRY, *Appellant,*

vs.

ASA WHITNEY, *Appellee.*

IN EQUITY.

No. 148.

ON APPEAL FROM THE CIRCUIT COURT OF THE UNITED STATES FOR THE SOUTHERN DISTRICT OF OHIO.

ARGUMENT OF CHAS. B. COLLIER FOR THE APPELLANT.

Butt & Co., Prs., 37 and 39 S. Third St., Phila.

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8. Reference made to Whitney's sworn statement in his extension application; showing that he *lost* $14,000 by his process in the first fourteen years of the Patent, and after expenditure of $52,000 in *improving* upon

the object, in common, of all such processes being to effect equality in contraction, and prevent inherent strains.

Prior to the year 1861, for many years, the appellant, Mowry, had been engaged in the manufacture of cast-iron car wheels at the city of Cincinnati, one stage of which manufacture consisted of a process of "annealing" the wheels for the purpose of preventing the occurrence of strains in the wheel which would have ensued but for such process: his process, prior to 1861, for this purpose, consisted in removing the wheels from their moulds as soon as they had cooled sufficiently to be capable of being handled, and placing them forthwith in pits, where sometimes with and sometimes without sand, they were excluded from the air and suffered to cool gradually, through the retention of their own heat; the time occupied in the process being about four days.

In the practice of this process he was complained of by no one, nor could any one have reasonably complained by reason of it, since it was a process that had long been in use, and a right common to every one who might choose to exercise it.

On the 7th day of May, 1861, Letters Patent were granted to Mowry for a process of annealing car wheels, which, stated briefly, consists in the employment of charcoal interlaid between the wheels, with provision for the admission of air to support the combustion of the charcoal, its ignition being caused by contact with the red-hot wheels.

Mowry, from about the date of his Patent, employed at his establishment a process of annealing in all material respects like that described in his Patent.

On the 21st day of March, 1866, the appellee, Whitney, filed his bill of complaint against Mowry in the United States Circuit Court, for the Sixth Circuit and Southern District of Ohio, setting up Letters Patent granted to him, Whitney, dated April 25, 1848, and extended for seven years from and after the 25th day of April, 1862, which Patent is, as stated in the grant, for a new and useful "*improvement in annealing and cooling cast-iron car wheels*," or, as stated in the "schedule," for a new and useful "*improvement in the process of manufacturing cast-iron railroad wheels.*"

Whitney's improvement, as patented, stated briefly, consists in removing the wheels, soon as may be, from their moulds, placing them forthwith in an oven previously heated to the same temperature as the wheels when placed therein, then gradually raising the temperature of the furnace and of the contained wheels "to a point a little below that at which fusion commences," then shutting off the heat and allowing the wheels to cool no faster than can be by the permeation of the heat through the wall

of the oven and its radiation from their outer surface, the claim being for the *combination* of the two elements—*re-heating* and *slow cooling*—and not for either element separately.

To the bill of complaint Mowry filed his answer and amended answer, admitting therein the grant to Whitney of his said Patent and the due extension thereof, but denying infringement, and alleging the invalidity of Whitney's Patent for want of novelty and for want of utility,

"*inasmuch as the said process would ruin and destroy the hardness on the rim of the car wheels, known as the "chill," and thus greatly detract from the usefulness and durability of the wheels.*"

A large amount of testimony being taken, on either side, the cause was brought to a final hearing on the pleadings and proofs, before Judge Leavitt, District Judge, at the January term, 1867, of said Circuit Court, and at the following April term, a decision was rendered in favor of the Complainant, Whitney, and against the Defendant, Mowry, and a decree entered April 5, 1867, finding that the Patent of said Whitney, and the extension thereof, was good and valid—

"that said improvement is useful, and that the Defendant, Albert L. Mowry, has infringed upon said Patent, and that the Complainant do recover of said Defendant the profits, gains and advantages which said Defendant has received," &c.

By the terms of said decree, the said cause was referred to a Special Master to take and state an account of the gains and profits which the Defendant had derived from the infringement of said Patent.

Pursuant to such decree and reference, the parties proceeded to take testimony as to such gains and profits; and on the 1st day of August, 1868, the Special Master filed a report containing two findings: (1). That the Defendant began the use of the process complained of (the charcoal process) in the month of April, 1861, and continued it until April 7th, 1867, making and selling thereby 19,819 wheels, the cost of which was $331,327 64, and the gross receipts from the proceeds of sale of which was $412,829 50; and that the profits realized by the Defendant on said 19,819 wheels, including interest to the first day of August, 1868, amount to $100,362 24.

(2). "That, on account of the charcoal and extra labor, the cost of the annealed wheels so manufactured was, on the average, twenty-five cents per wheel more than the cost of the same wheels without the use of the charcoal, or the re-heating process would have been; and that no addition was made to the price of wheels on account of their having been manufactured by said process of re-heating."

On the 17th Sept., 1868, the Special Master filed a supplemental report stating that the figures as set forth in his original report were incorrect, and that the total profits of Mowry derived from the manufacture and sale of said 19,819 car wheels, including interest, was $111,486 07. In this, the supplemental report, the Master also finds

"that Mowry, prior to April, 1861, had, without the use of the process complained of (that is, by his process of annealing by slow-cooling in pits), built up his business to its then condition; that the process complained of increased the cost of manufacture—as set forth in second finding of the original report; that if the 19,819 wheels made by the use of the process complained of (the charcoal) had been made by the process employed by Mowry prior to 1861 (the slow-cooling), and been sold at the prices they actually did bring, would have yielded Mowry a profit of $4,754 75, greater than he did actually realize; that the Defendant, Mowry, did not, when he began the use of the process complained of, nor while he continued it, make any difference in the *quality of iron* used for wheels, nor in the *weight* or *form* of car wheels, nor, by reason of the use of such process, *in their price*; that Mowry was unable to discover that his business was increased by the use of such process, and had difficulty in introducing the charcoal-treated wheels; that the railroad companies for one or two years purchasing from Defendant, preferred the old wheels, that is, those manufactured by the process used by the Defendant prior to 1861 (the slow-cooling); and that since the Defendant has been enjoined, and has abandoned the process complained of, he has had the same customers as before (except the Little Miami, and Columbus and Xenia R. R. Companies, 'and it does not appear that said companies have withdrawn their custom on account of said abandonment,') and has sold the wheels he has since manufactured without the process complained of, as readily as those manufactured by the use of said process, and at the same prices.

"That since the Defendant abandoned the process complained of, he has made a wheel called the Washburn wheel, more properly called the Atwood wheel, not exactly after Washburn's Patent, but in a modified form—*the same as before* and during the infringement—using pits made of iron sunk in the ground, taking the wheels from the mould at the same degree of heat as in the process complained of in the cause, placing them in the pits without any fuel, covering the pits up; leaving the wheels in four or five days; then taking them from the pits, and allowing them to cool in the open air.

"That in the manufacture of the wheels referred to in the original report, the Complainant used no process for annealing or slow-cooling except that complained of.

"That the Complainant, Whitney, in 1849, granted a license under his Patent at $1.00 per wheel, under which a few wheels were made and paid for, and the license was then revoked and cancelled.

"That in 1851 he granted another license, under which no wheels were made, and it was soon cancelled.

"That in 1847 Whitney started the business of manufacturing car wheels by this process, in company with his son, George Whitney, who had one-third interest in the firm; that from 1850 to 1861, both inclusive, Complainant continued said

business with his sons, as A. Whitney & Sons, the firm paying Complainant $1.00 per wheel aside from his proportion of the profits; said $1.00 per wheel being charged to the expenses account of the business.

"That since 1861, said firm have continued said business, the Complainant putting in his Patent without charging the royalty theretofore charged, and the firm paying the expense of procuring the extension in 1862.

"That otherwise than as aforesaid, the Complainant has kept the right under his Patent, declining to grant licenses, etc."

To this supplemental report of Sept. 17, 1868, exceptions were taken on behalf of Whitney to so much thereof as found that Mowry did not, by reason of the process complained of, make any difference in the quality of iron used for wheels, nor in weight or form or price of wheels; also to the finding, that "the Defendant was unable to discover that his business was increased by the use of said process," &c.

To the same supplemental report exceptions were taken on behalf of Mowry. (1) "Because it is incomplete; the Master has stopped short of the ultimate inquiry, * * * * * * but has made no apportionment of profits," &c.

Also because the cost of said wheels is not correctly stated.

Also to the item of interest, because the Complainant is not entitled to recover interest, and because the interest is calculated upon the entire profits of Defendant's car-wheel business; and further, because such profits, and consequently the interest, is erroneously stated.

On the 7th October, 1868, the Master filed another report, in which, while declining to make certain findings as requested by Counsel for the parties, respectively, he does find and report, as follows, to wit:

"That, prior to the time of the adoption by the Defendant of the Complainant's improvement, he, the Defendant, prolonged the time of cooling his wheels by placing them in pits covered with dry sand, in some cases using air-tight pits without any sand; placing the wheels in the pits, and allowing them to remain there four or five days; that by reason of such treatment they were finished and made ready for the market, and without further treatment were sold."

The cause came on to be heard on these several reports and the exceptions thereto on the 21st October, 1868, before Judge Leavitt and Mr. Justice Swayne, and after argument on behalf of the parties respectively, the opinion of the Court was delivered by Mr. Justice Swayne, which will be referred to more fully hereinafter, but from which we now quote as follows, to wit:

OPINION OF THE COURT AS DELIVERED BY JUSTICE SWAYNE.

"The only question before us, as the case has been presented in the arguments just closed, is whether by the Master's Report, as it stands, the Plaintiff is entitled to the entire amount of profits which have been made by the Defendant as estimated. If that be clear, we need no further light on the subject, and there is no necessity for referring the matter back to the Master for a further report, and for him to take further testimony in the case, leading to the proper solution of this point.

"The claim of the Patent is as follows: 'I do not claim to be the inventor of annealing castings made of iron, or other metal, when done in the ordinary way.' That ordinary way is well understood in the history of the arts, and need not be remarked upon. 'Nor do I claim to be the inventor of any particular form or kind of furnace in which to perform the process.' There is here a clear implication and recognition of the right of others, notwithstanding the Patent of the Plaintiff to perform this annealing process, in the ordinary way, by means of a furnace used for that purpose."

(Quotes claim in full.)

"Here, it will be observed, in relation to this claim, that two things are claimed, and every thing else is disclaimed:

First, the re-heating of the wheel to be annealed, and that re-heating, in connection with the slow-cooling process, which slow-cooling process was known before in the history of the art.

"The re-heating is that which is claimed to be new, and which this Court has found, heretofore, to be new; this combination of the re-heating with the old thing—the slow-cooling of the wheel."

* * * * * * *

"Here the roads fork and the divergence commences. Now any person, irrespective of this Patent, after the wheel has reached the point mentioned, would have the right, in consistency with this Patent, immediately to put it into a pit—the right would exist, as I understand is conceded, to apply hot sand, sand previously heated—the right would exist to close the pit, and exclude the air, and to subject the metal to the annealing process by slow-cooling, as the phrase is, to such extent as this means or any other means known in the history and practised in the art of annealing prior to that time, might suggest. The Plaintiff then, availing himself of all these means and instrumentalities, interposes, in the progress of the construction and completion of the wheel, a new element, the right to use which exclusively is secured to him; and that new element is simply, after the wheel has been taken from the mould, and has been placed in the pit, to subject it to a re-heating or tempering which involves the re-heating of the iron structure; and then that re-heating is to be connected with the old process of slow-cooling. In this re-heating, in combination with slow-cooling, lies the novelty, the utility, the vitality of this Patent.

"Viewing this subject in this light, it does not seem to us that there is anything in the case, any fact or feature which should take it up from the rule laid down by

the Supreme Court and which stands unshaken in the case of Seymour *vs.* McCormick, 16 Howard.

"Now I have referred to this extent upon the case as presented, irrespective of one element, to which I am now about to address myself, and in reference to which I submitted to Counsel who argued this question one or two inquiries, the answers to which then seemed to me, and still seem to me, to be very material, and which I understand are not answered by the report of the Master.

"There is proof in the case that car wheels, annealed in modes known in the history and application of the art, otherwise than by the mode involved in the invention of the Plaintiff, have a market value—that they have been sold and used—that they are still sold and used. But upon this subject the proof is not clear or full, nor by any means conclusive. Nor has the Master categorically reported upon this particular point.

"All this is preliminary, as it regards this view of the subject and this proposition. If the proof were, that when the wheels were made up to that point—when they are to be subjected to some annealing process—if the proof were that the wheel, at that point, was worthless—had no actual or market value—was worth nothing to the maker, and could not be of any value to him until subjected to the process covered by the Plaintiff's Patent, then, *perhaps, and I use that word upon reflection*, then, perhaps, it might be said that if the wheel had no value before being annealed according to the process of the Plaintiff, and after being so annealed, its value involved a particular amount of profit, more or less; perhaps it might be said the entire amount of profit made by the manufacture of the wheel was due to the process of the Plaintiff, and that, therefore, would be the standard and measure for the recovery of damages.

"Now the Master, as I understand, has not presented the case in this aspect. Irrespective of this particular aspect, we have no hesitation in saying that this is a case proper for the apportionment of damages.

"But it seems to us that it might as well be claimed that the Plaintiff was entitled to the entire profit of the running gear, other than the wheel, or upon the entire car, involving the running gear as well as the body of the car, as the entire profit made upon this wheel.

"The Master has not reported on this subject; and here it seems there is clearly wanting an element to enable us to arrive at a proper conclusion on this particular point.

Immediately following the delivery of the said opinion, an order was entered in said cause (Oct. 22, 1868,) as follows, to wit:

"This cause came on to be heard upon the reports of the Master, and the exceptions thereto, and was argued by the Counsel of the respective parties, whereupon it is ordered by the Court that the said Master take further testimony, and report to the Court what proportion, if any, of the profit made by the said Defendant was due to the use by him of the Complainant's invention and that in connection with this subject, he report:

"*First*, whether the wheels made and sold by the Defendant had, or could have been made to have, any market value without being subjected to the process patented to the Complainant.

"*Second*, If they had, or could have been made to have, such value, by any annealing, or slow-cooling process, outside of the Complainant's Patent, how much additional, and greater market value, if any, they derived from being subjected to said patented process.

"It is further ordered that said testimony shall be taken within sixty days from the time of the entry of this order, that the said Master shall file his report within forty days thereafter, and that either party may file exceptions within thirty days thereafter, and this cause is continued."

Pursuant to such order of re-reference, the Counsel for Mr. Mowry proceeded to take the testimony of car-wheel makers and users in different sections of the country, the persons examined including some of the most extensive manufacturers and users of wheels in the United States; the entire testimony being that wheels slow-cooled—that is, without extraneous heat, and as practised by Mr. Mowry prior and subsequent to the use by him of his charcoal process—had a market value equal to that of wheels in the manufacture of which the combined process of *re-heating*, in connection with slow-cooling, was employed. One of the witnesses—*Lobdell*, of Wilmington—testifying that he had used the slow-cooling process since 1847, and was making and selling thereby 30,000 to 50,000 wheels per year, and at prices equal to Whitney's.

No testimony was taken on behalf of the Complainant to disprove such fact, but the Complainant was himself examined, and two other witnesses called in his behalf, to prove the *date* of Whitney's invention.

On cross-examination of Mr. Whitney, in answer to a question as to the comparative market value of his wheels and those of manufacturers who cool them in pits with or without sand; he testifies that his prices were fixed

"*without reference to the price of other manufacturers; that his prices were generally lower; that when he changes other manufacturers immediately come down to his prices; that his only competitor to any extent is Mr. Lobdell of Wilmington, who has in a few instances put the price a fraction lower than his, Whitney's.*"

The Counsel for Mowry also put in evidence Whitney's extension record, in which he states, under oath, that

"there is no essential difference in the *cost per pound of making* cast-iron chilled car wheels of the *various patterns, and by the different modes in use*, providing the same skill and system control the manufacture; but by my process I am enabled to make them lighter than those made in any other way for a similar service, and I can therefore afford to sell them at the same price per wheel as other makers, and save the cost of the difference in weight. *This saving of metal, therefore, I deem to measure the essential advantage I have over my competitors, and also the profits arising from my Patent.*"

* * * * * * * * *

"I therefore deem *ten* pounds per wheel as an average difference of weight between my wheels and those of other makers."

The result of the first 14 years' practice by Whitney; account being thus stated in his sworn statement:

"The cost of experiments and changes of structures for developing the improvement patented has exceeded the profits as before stated thus:

Say expenses	$52,970 31
Profits (saving of metal)	38,346 00
Deficit	$14,624 31

It will be observed, that while Mr. Whitney in his deposition under the last order of reference testifies that his prices for his wheels have generally been the same, or lower, than the prices of other manufacturers (see printed record, p. 335, answer to +Q. 50,) and so testifies in presenting his extension application, he, nevertheless, in his deposition under the first order of reference (see printed record, p. 195, answer to Q. 2 in-chief) testifies that * * *

"consequently the wheel (his) sells more readily, at least by a difference of $1.00 a wheel more than those made in the ordinary way."

Again, it will be observed that Whitney, in his deposition under the first order of reference, testifies that "from 1850 to 1861, both inclusive, I was paid a dollar a wheel, aside from my proportion of the profits of the business, that account, $1.00 per wheel, being charged to the expense amount of the business," and presents and makes an exhibit to his deposition (see printed record, page 197), entitled "royalties," a tabular statement, taken from the books of A. Whitney & Sons, showing the payment to him by them "for the use of his Patent in making car wheels" a sum amounting in the aggregate to $237,494; all of which was prior to his application for extension.

It will be observed, further, that in his extension account (see printed record, pages 373-4), sworn to by him, February 4, 1862, he, Whitney, represents his only profits under his Patent as having been a *saving of metal*, supposed to be, on an average, ten pounds per wheel, amounting, on the aggregate number of wheels made during the original term of the Patent, in money, to $38,346 00, leaving him a *loser* by his Patent to the extent of $14,624 31, no disclosure being made of the "royalties" and other large sums, which, in his deposition of August

27, 1867 (record, p. 194-7,) he testifies to having received under the original term of his Patent.

In view of these disclosures and of the fraud practised by Mr. Whitney in procuring the extension of his Patent, the Counsel for Mr. Mowry, by leave of Court, filed a motion, supported by the affidavit of Mowry, and exhibits—see record pp. 404-410—setting up the deceit and fraud so practised by Whitney, and asking to have the original interlocutory decree vacated, and for leave to set up such fraud by way of amended and supplemental answer.

Upon this state of proof the Special Master, on the 23d of March, 1869, filed his report, wherein, among other things, he reports and finds as follows, to wit:

"But I find that wheels of the material, size, shape and weight of those manufactured by the Defendant could have been manufactured without the use of extraneous heat, and at a less cost, by either of the methods described in finding V. of this report (that is, in pits with or without sand,) and that the wheels so manufactured would have had the same market value in the market where the Defendant sold said 19,819 car wheels, as if extraneous heat had been applied to them as described in the Complainant's Patent, or as used by the Defendant."

By consent of Court and Counsel the cause was finally heard at the city of Washington, in the month of December, 1869, on the motion of the Defendant—appellant—to vacate, &c., and the questions arising on the Master's final report and the exceptions thereto before Mr. Justice Swayne, who, in July, 1870, made the final decision and signed the final decree of the Circuit Court therein, which was enrolled October 4, 1870.

In his final opinion and decree Mr. Justice Swayne overrules, on the authority of the *Rubber Company* vs. *Goodyear's Executor*, the motion of the Defendant—appellant—to vacate the original decree and for leave to amend, &c., based on said alleged fraud of the Complainant—appellee.

The several findings of the Master—

"that Mowry had, prior to the use of the process complained of, slow-cooled his wheels in pits and by the use of such process built up his business to its then condition; that he did not when he commenced the use of charcoal, nor afterwards while he continued its use, make any difference in the quality of iron used for the manufacture of car wheels, nor in the form or weight of wheels, nor, by reason of the use of such process, in their price; that it was with a great deal of difficulty he introduced the charcoal-treated wheels; that, as to the 19,819 wheels, in the making of which the process complained of was employed, the same could have been finished without the re-heating process—first, by placing them in pits as soon as they could be handled, covering them with hot sand, and thereby slow-

cooling them. Second, by placing them in like manner in pits, without any fuel, covering the pits, and thereby slow-cooling them; that said 19,819 wheels could have been so manufactured without the use of extraneous heat, and at less cost, and would have had the same market value in the market where the Defendant sold said 19,819 car wheels, as if extraneous heat had been applied to them, as described in the Complainant's Patent, or as used by the Defendant."

All these findings are *confirmed.*

The learned Judge, in his said opinion, also refers to the admission made at the original hearing of the cause, by one of the Counsel for Mr. Whitney, Mr. Fisher, and not dissented from by the other, that slow-cooling was in use prior to Whitney's invention, and that slow cooling without re-heating would not be an infringement of the Patent and an exception taken on behalf of Mr. Whitney to a part of the final report in the words as follows:

"Complainant excepts—

"1st. Because there is no evidence to show that the process of slow-cooling was old, nor to justify the Master in finding that it was old."

Is in the final decree overruled.

The final decree, however, awards to Mr. Whitney the difference between the *cost*—as reported by the Master—and *proceeds of sale* of said 19,819 wheels, to wit..... $91,501 86

Interest to date of original report (Aug. 1, 1868,)..... 19,984 21

" on $91,501 86 (from Aug. 1, 1868 to Aug. 1, 1870,) 10,980 22

$122,465 29

Costs of suit to be taxed at..... .....$

Interest on the aggregate sum, other than costs, from August 1, 1870.

While the general costs have not been taxed by the Clerk of the Circuit Court, the record shows that the Master has charged $50 *per diem* for his services (see record, page 261,) and upon his, the Master's application—see record, page 401-412—has been allowed by the Court the said charges, amounting, with $25 paid by him for service of subpœna, etc., the sum of $3,205 90, and that said sum has been paid by Mr. Whitney, "to be recovered from the Defendant, if, upon the final disposition of this cause, the costs of the Master aforesaid be taxed to the Defendant."

From the final decree of the Circuit Court an appeal was prayed by the Defendant—appellant—and allowed; a bond was filed and approved by the District Judge; a notice and petition of appeal was also duly filed—see record, pp. 412-416.

Thus the several matters presented to the Court upon the pleadings and proofs, including the questions of novelty, utility and infringement, presented to and decided by the District Judge, and the very important questions arising upon the reports of the Master, and the other proceedings had after the entry of the decree referring, and the order recommitting the case to him, have been brought to this Court of last resort for determination, and will be considered in their order.

Hotchkiss v Greenwood
11 How 248
Lish v Hague
Webster Pat Cas 207
Burke v Aston 8 Ellis
& Blackb 478
Same 32 Law times 341
Bush v Fox 26. L & Eq
464. (Same House of
Lords)
38. L & Eq 1-5

1. Whitney's Patent is invalid for want of novelty, his process being, at most, simply the application of a well-known process to a purpose analagous to those purposes to which, long anterior to his alleged invention, it had been applied.

In support of this proposition the following authorities will be referred to:

Curtis on Patents (Edition of 1867), Sec's 53–56.
Howe vs. *Abbott*, 2 Story's Rep., 190.
Winans vs. *Boston & Prov. R. R.*, 2 Story, 412.

2. Whitney's Patent is void because that which is described and claimed therein is not useful, inasmuch as such process would destroy the hardness of the rim, (known as the "chill") of the wheels, and thus greatly detract from the usefulness and durability of the wheels.

As collateral or subordinate propositions to the last, the following points are submitted:

A. That a "chilled" periphery, or tread, is an essential feature to a useful car wheel.

B. That Whitney's Patent designates and provides for such degree of re-heating, and none other ("*a little below that at which fusion commences*") as will destroy the "chill."

3. The process as conducted by the Defendant did not infringe the Patent of Whitney.

STATEMENT OF ERRORS OF THE DISTRICT JUDGE ON WHICH HIS DECISION WAS BASED.

First. The *argument* of the Court, by which the ultimate conclusion was reached, is incongruous, in this, to wit: that, in considering the question of *novelty*, Whitney's Patent is protected as against prior annealing processes by reason of such prior processes being confined, as stated by the Court (an error of fact), to "unchilled" articles, and Whitney's to "chilled" articles; whereas, in considering the question of *utility,* the Court held—"If it were conceded that the heat provided in the Patent was to *destroy the chill,* I should hesitate to pronounce the Patent invalid."

Second. The Court erred in construing Whitney's Patent, the error appearing in the concluding paragraph of that portion of the opinion now quoted, to wit:

"He, Whitney, avoids the point of incipient, or actual fusion, but *requires* the heat to be a *little* below that point. * * *

It is not supposable that the inventor intended what would destroy the very object he had in view, namely: to make a wheel *in which the chill of the periphery should be preserved*, and the inherent strain from unequal contraction avoided. I am clear that the Patent may be regarded as claiming, by the fair import of the words, "a little below the point of fusion," *such a degree of heat as is necessary to effectuate the intention of the inventor.*"

In considering the question of *construction*, under the above proposition, the following authorities will be referred to:

Curtis on Patents (Edition of 1867), Sec's 227, 228, 229.
Evans *vs.* Eaton, 7 Wheaton, 356.
U. S. Patent Laws, Act of 1836, Sec. 6.
Derosne *vs.* Farie *et al.*, Webster's Patent Cases, 165.
Morgan *et al. vs.* Seward *et al.*, " " 174.

Third. The Court erred in deciding the issues of *novelty*, *utility* and *infringement* in favor of the Complainant—appellee—such decision being based, not only on errors of law, but being also contrary to the weight of the evidence.

The foregoing points will be considered in the order as they are stated.

I. Whitney's Patent is invalid for want of novelty, his process being, at most, simply the application of a well-known process to a purpose analagous to those purposes to which, long anterior to him, it had been applied.

Under the notice contained in the Defendant's—appellant's—answer, many printed publications descriptive of annealing processes in use anterior to Whitney's invention were put in evidence, and considerable oral testimony taken upon the same point.

A few quotations from the evidence introduced upon this point will be given, to wit:

(From the Artist's Manual, &c., published by James Cutbush, Philadelphia, 1814.

"*Annealing.*—When a substance melted, or nearly in a state of fusion, is cooled very hastily, its texture is so much altered, that, if a ductile metal, it loses much of its malleability, and cannot be extended far under the hammer without cracking: or if a brittle metal, a glass or vitrescent mixture, it is liable to fly to pieces by a very slight temperature or external injury. To avoid this, the process of annealing is resorted to, which is nothing more than cooling the heated or melted substance as slowly or equally as possible, often in a separate furnace of the requisite heat, and sometimes called an annealing oven. The utility of annealing is shown very conspicuously in the manufacture of glass, the casting of speculum metal, or the heating of gold.

* * * * * * *

"By the process of annealing the glass is preserved for some time in a state *approaching to fluidity*. * * * * * * *

"A similar process is now used for rendering kettles and other vessels of cast iron less brittle, which admits of the same explanation as that above stated."

Philosophical Transactions. Royal Society of London, 1840. Account of Experiments on the Reflecting Telescope. Lord Oxmantown.

"Describes at length, and in detail, experiments as to best alloy for speculum metal," &c.

* * * * * * *

"It was evident that the flaws of so frequent occurrence in the plates formerly cast, and also their extreme brittleness, arose from the contraction of the metal in some places more than others, just at the time of transition from the fluid to the solid state. *The edge of the plates* always became solid first, and the central portions, thus prevented from contracting, were *strained* when no longer ductile.

* * * * * * *

"When the metal has become solid in the ingate or hole through which it enters the mould, the plate is to be removed quickly to an *oven heated a little below redness* to remain till cold, which, where the plates are nine inches diameter, should be three or four days at least."

Holtzapfel's Turning and Mechanical Manipulation. London, 1843.

* * * * * * *

"Speculum metal is perhaps the most intractable of any of the alloys, and it serves to illustrate, in a most striking manner, many of the effects that occur in castings generally. Small speculums are cast in sand. As soon as they are set the sand core is pushed out of the aperture in such as are intended for Gregorian telescopes, to enable them to contract without fracture, and the *red-hot* disc is surrounded by ignited wood ashes, or any very bad conductor, to delay the cooling;

* * * * * * *

"The plan ultimately adopted was the porous hoop-iron mould, with a marginal ring of sand. The mould was heated to about 212 degrees F. It was filled very quickly, and the moment the metal was solidified, it was drawn into *an annealing oven, previously heated to about the same temperature as the casting;* so that for small reflectors of nine inches diameter the cooling might be extended over about three days, and for large ones of thirty-six inches diameter, over about fourteen days. With these precautions, the process was uniformly successful," &c.

"*Paul A Sabbaton* testifies that, prior to 1847, he annealed castings—machinery cog-wheels four feet in diameter—by taking them as hot as they could be removed in safety from the moulds, and placing them in the 'dump of the cupola'—that the 'dump of the cupola' was hot coals out of the cupola, and 'the heat applied to the wheels was very great.'" (Rec., p. 120. Abst. Rec., p. 31)

"*George G. Lobdell* testifies that, prior to 1847, he knew of small pulleys to be placed in iron vessels, or any old pot, with charcoal and iron trimmings packed around them, and this pot placed under the cupola; the contents of the cupola hauled out, covering the pot, both for the purpose of making them soft, so that they could be turned easily, and for the purpose of preventing the arms from

fracture; that the cause of the fracture of the arm of a pulley was because one part remained hot longer than the other; *consequently, the hub being the heaviest part of the pulley and the last to cool, would produce a strain on the arm when it is cooled or contracted; this process caused all parts of the pulley to cool alike.*" (Rec., p. 130; Abst. Rec., p. 33.)

"*Major Wm. Wade* testifies that, 'in 1831 I became interested as one of the owners of an iron foundry in Pittsburgh, and was engaged in conducting its operations until 1839. During that period it was a common practice to anneal iron castings in a reverberatory furnace. One of the methods practised was to place the castings, while red hot on the furnace hearth, as soon as practicable after the melted iron was discharged from it, and then to cover them with dry sand or cinders, or keep them covered closely until the following day.'" * * * *

"'Another method was to imbed the castings in the sand beneath the hearth before lighting the furnace fire, and to keep them in this position where they would be heated by the flame and the melted iron in the furnace, and where they would remain until they were very slowly cooled.'" * * * *

* * * * * * * * * *

"'In my opinion, the process practised by me at my foundry in Pittsburg, between 1831 and 1839, in principle and mode of operation, was essentially the same as that described in the specification and Letters Patent of Mr. Whitney. The same philosophical principles were involved, and the same effects produced by the two processes.

"'In my process, the castings were placed on the hearth of the furnace in which the metal had been melted, and raised to a very high degree of heat after fusion, so that the hearth and walls of the furnace were of about equal heat to iron at its fusing point, when these castings to be annealed were placed within it.

"'They immediately acquired heat, and were raised in temperature; they were covered over with hot sand so as to exclude the air, and the whole mass raised to a still higher temperature by the heat which the hearth and walls gave off until equilibrium was produced, when the furnace, sand and castings were cooled slowly and evenly by radiation. The castings being covered perfectly by the sand, a good non-conductor, were in a confined atmosphere, and cooled as nearly simultaneously as practicable for castings to cool. It is impossible to cool a casting in every part at the same time,'" &c.

(Rec., pp. 158-9; folio 312-13.)

"*Joseph Kaye* (foreman 'Fort Pitt' Works) testifies, 'As long ago as 1837 I cooled cog-wheels two feet in diameter, pulleys and other castings, by taking them red hot from the moulds in which they were cast, and immediately placing them in the ash pit of the furnace, and raking down a large quantity of red-hot coals upon them, completely covering them, and permitted them to remain there until the whole cooled by radiation, which occupied about one day.'"

In Curtis on Patents (Sections 53-56, Edition of 1867,) the law bearing on the subject of *double use* is thus stated, to wit:

"Hence it appears that the presence or the absence of the *patentable* quality of *novelty* depends in some degree on the position in which the supposed inventor stands with reference to the history of the art; for there may be, in what he has done, an element of novelty, and yet that novelty may consist only in the new occasion, or new use to which he applies an old or well-known method. Thus the principle, that is to say, the method of operation, or the order of combination under which his invention ranges itself, may have been discovered and applied before, but not on precisely the same occasions, or uses, or with the same materials.

"When this is the case, the question to be determined is, whether the new application is anything more than a *double use*, or whether something has been discovered, or some effect produced which goes beyond the mere skill of a constructor, in adapting a well-known method to different occasions, and enters the domain of what is called invention."

* * * * * * * * *

"In order to escape the objection of a double use, it is necessary that the new occasion or purpose to which the use of a known thing is applied, should not be merely analogous to the former occasions or purposes to which the same thing has been applied. There is a very material distinction between applying a *new contrivance* to an *old object*, and an *old contrivance* to a *new object*.

"The *former may be patentable*, but the *latter cannot be* when the new object is merely one of a class possessing a common analogy." * * *

Now in view of the testimony, what *invention* was made by Mr. Whitney? what is the argument by which, if at all, his Patent is to be sustained?

Surely, in order that his Patent may be sustained, there must have been some invention on his part; the element of *novelty* must somewhere be found.

The *grant* by the Government to him, as stated therein, is for an "*improvement* in annealing and cooling cast-iron car wheels:" the schedule of his Patent recites that he has made a new and useful "*improvement* in the process of manufacturing cast-iron railroad wheels;" he then describes his process, which consists in taking the wheels red hot from their moulds, placing them in this state into a furnace or chamber that has been previously heated to a temperature as high as that of the wheels when taken from the moulds, then closing the furnace and gradually raising the temperature of the furnace and its contents to a point a little below that at which fusion commences; then closing all the avenues to and from the chambers and allowing the wheels to remain in the chamber until, by the permeation of the heat through the walls of the furnace and radiation from its outer surface, the whole cools.

Now, Mr. Patentee, what is the object of your patented process? Let the Patent answer: "By this process all parts of each wheel are raised

to the same temperature, and the thinnest and thickest parts cool and shrink simultaneously together, which relieves them *from all inherent strain* when cold."

The *ultimate* purpose, then, is to relieve the wheels from inherent strain. Now, I ask, is not this the very purpose of the prior processes described in the testimony?

It must be admitted that it was.

Perhaps, however, the Patentee has invented some new and improved kind of "furnace or chamber?"

A further examination of his Patent shows this is not the case, for he says:

* * * "Nor do I claim to be the inventor of any particular *form* or *kind* of *furnace* in which to perform the process."

Again he tells us:

"I do not claim to be the inventor of *annealing* castings made of iron or other metal *when done in the ordinary way*."

Now this is a *negative pregnant*, and equivalent to an affirmation, *first*, that there was some "*ordinary*" method or methods of annealing car wheels which he does not wish to claim, and *second*, taken in connection with the words immediately succeeding (his "claim"), that there was an *extraordinary* or new method that he does wish to claim: that method is thus stated in the Patent:

"But what I do claim as my invention, and desire to secure by Letters Patent, is the process of prolonging the time of cooling, in connection with annealing railroad wheels in the manner above described—that is to say, the taking them from the moulds in which they are cast before they have become so much cooled as to produce such inherent strain on any part as to impair its ultimate strength, and immediately after being thus taken from the moulds, depositing them in a previously heated furnace or chamber, so constructed, of such materials, and subject to such control, that the temperature of all parts of the wheels deposited therein may be raised to the same point (say a little below that at which fusion commences), when they are allowed to cool so fast and no faster, than is necessary for every part of each wheel to cool and shrink simultaneously together, and no one part before another."

As to what was the "*ordinary*" method of annealing, *specifically applied to car wheels*, that was in use prior to Whitney's Patent, we are told by his witness *Knight*—(record, p. 39):

"The purpose and effect is in both (Whitney's and Mowry's) simply to anneal the wheel situated within the chill, without materially impairing the latter.

"This result Whitney discovered he could accomplish, so as *more perfectly* to anneal the wheels, without materially impairing the chill, by the use of *external heat over and beyond the heat of the wheels; the previous mode of annealing* the wheels having been to prolong the cooling of the wheels merely by *heating* sand, or other slow conductor around them."

Mr. Coleman Sellers, another of Mr. Whitney's witnesses, after referring to the state of the art, tells us—(record, p. 49):

"+Q. 6. In your opinion, then, is that part of Mr. Whitney's process of taking the castings at a red heat from the moulds and placing them in a previously heated chamber or pit, for the purpose of prolonging the time of cooling, simply new?

"A. I do not think that that of itself is a novelty, *irrrespective of the temperature to which the pit has been previously heated.*

Mr. Enoch Lewis, another of Mr. Whitney's witnesses, testifies—(record, p. 63,):

"+Q. 2. The principle, then, involved or embraced in Mr. Whitney's Patent of annealing castings by prolonging the time of cooling, *permitting the thick and thinner parts to adjust themselves* to each other during the process of cooling, was not new or original with him, was it?

"A. I cannot say that it was. I do not think it was."

It must be conceded, in view of the testimony, that long prior to Whitney's Patent the *fact* was observed as to all metallic castings that if removed from their moulds, and cooled rapidly, they would be subject to inherent strains, especially if the article was one of inequality in thickness of parts, and by reason of the parts not contracting uniformly; such *fact* or *effect* being observed, it is also true that the means of obviating it was also discovered and practised, such remedial or preventive process being termed "annealing." It is also true that the proofs distinctly show that anterior to Whitney many different kinds of articles, such as glass, speculum metal, *pulleys, cog-wheels, gun-carriage wheels and large machinery wheels*, were subjected to annealing processes by which the articles were taken red hot from their moulds, and annealed and slow-cooled by the application to them of *extraneous heat;* in many instances ovens *previously* heated being employed.

It is true that some of the references (Jamieson's Dictionary e. g.) says:

"By the process of annealing the glass is kept for some time in a state approaching *fluidity*" (the same process being described as applicable to cast iron articles).

All these facts must be admitted; now, what is the argument?

Mr. Whitney's expert's (Renwick) argument (which will be found in his answers to questions 9 and 10 in-chief, relative to the "Jamieson's Dictionary," reference, Rec., p. 98; also p. 102 "Holtzapfel," "Earl of Rosse," reference, and in his re-examination and re-cross-examination, pp. 117–119, as to all the references,) is as follows:

"Neither of said (printed) references describes any improvement in the process of manufacturing cast-iron railroad wheels. Neither one leaves the material of the article upon which it operates in the same two conditions that the material of the article subjected to the Complainant's process is left in; that is, with one portion of said material *crystalline, hard* and *brittle* (the "chill"), and with the other portion thereof comparatively granular, soft and tough. On the contrary, the material of the whole of the articles subjected to either of the processes described in said article, (Jamieson's Dic.) is left uniform throughout.

In the process of annealing glass, as described in said extract, the articles to be operated upon are taken in a hot state; but there is no description that they are to be subjected to a regulated heat by which their temperature is raised until all parts are *raised* to the same point, *which is an essential step in the process of the Complainant;* on the contrary, the articles of glass are described as being *gradually cooled* from their hottest to their coldest state, the application of heat in the annealing process being simply for the purpose of delaying the cooling, so that it takes place more gradually than otherwise it would."

The affidavit of Mr. Renwick (Rec., p. 19,) contains the following argumentative statement:

"The process pursued by Mowry and Whitney is in fact based upon the *discovery* which, so far as I know, was first made by said Whitney, viz: *That the chilled cast iron, constituting one part of the wheel, could be subjected to a heat less than fusion without producing any material effect upon its hardness,* while the cooling of the remainder of the wheel could be so prolonged, by the application of heat derived from burning fuel, as to enable all parts of the wheel to cool without being subjected to the strains incident to unequal contraction."

In the paragraph quoted from Renwick's affidavit is contained the germ of the argument heretofore advanced by the learned Counsel for Mr. Whitney to protect his Patent from the charge of want of novelty; and it was sustained by the District Judge.

Merely remarking that Renwick's statement is open to the verbal criticism that no "discovery" is mentioned, or hinted at, in Whitney's Patent, I have to say that the cardinal and underlying *fact* on which such alleged discovery is based *does not exist.* This brings to us the consideration of our second point, which is intimately connected with the first, and if sustained by the testimony utterly destroys the only possible argument (the "discovery," &c.,) upon which the novelty of Whitney's process can be sustained.

II. Whitney's Patent is void because that which is described and claimed therein is not useful, inasmuch as such process would destroy the hardness of the rim—known as the "chill"—of the wheels, and thus greatly detract from the usefulness and durability of the wheels.

This proposition, as well as the first, involves, obviously, mixed questions of construction and of fact, each of which we shall endeavor to consider, but before doing so would, with all due respect, remark that the decision of the cause by the District Judge was predicated on *three controlling errors*, and was characterized by a strange incongruity, a brief consideration of which is quite pertinent to the proposition last advanced.

The learned Judge adopts the argument of Mr. Renwick, advanced to protect Whitney's Patent from the charge of *double use* by reason of prior annealing processes; that is, that such processes, where extraneous heat and ovens were employed, so far as proved, were not applied to articles cast within a "chill;" the language of the Court being:

"I have not deemed it necessary to advert to the publications referred to in the Defendant's answer, as anticipating the Complainant's invention. They prove undoubtedly that the process of annealing metals has been long known, and that various plans and modes of accomplishing it have been described by scientific writers. But the evidence is clear, that casting railroad car wheels is a distinct branch of the art of casting, and that none of the printed Works referred to describe or apply to that art.

"One witness, examined as an expert (Renwick), and apparently well acquainted with mechanical science, testifies that in none of those Works is the Complainant's process of making car wheels alluded to or described. There is some reference to annealing wheels other than car wheels, but none to any wheel *cast within* a *chill*, and therefore it has no application to the process described by, and patented to the Complainant."

* * * * * * *

Again:

In the description of his process he provides, after requiring the wheels to be thus placed, that "*the temperature of the furnace or chamber, and its contents, be gradually raised to a point a little below that at which fusion commences.*" These words are substantially repeated in the claim in a parenthesis, in this form: ("*say a little below that* [*the point*] *at which fusion commences.*")

It must be conceded that this claim, as to the degree of heat to which

the wheels are to be subjected, is not stated with the precision and definiteness that is desirable

* * * * * *

"He avoids the point of incipient or actual fusion, but requires the heat to be a *little* below that point. This expression clearly imports some latitude of discretion in the operator."

* * * * * * *

"*It is not supposable that the inventor intended what would destroy the very* OBJECT *he had in view, namely: to make a wheel in which the chill of the periphery should be preserved*, and the inherent strain from unequal contraction avoided. I am clear that the Patent may be regarded as claiming, by the fair import of the words, 'a little below the point of fusion,' such a degree of heat as is necessary to effectuate the intention of the inventor."

We have, in that part of the opinion first above quoted, as it were, a *shield* thrown around Whitney as against prior annealing processes, because they were not applied to articles cast within a "chill," and having thereby a 'chilled" periphery produced upon them. We have, in the paragraph last above quoted, a reference to the specification and claim of Whitney's Patent, a distinct recognition that the very *object* of the Patentee is so to anneal wheels as to *preserve the chill*, and a liberality of construction—a "*latitude of discretion in the operator*"—as to the degree of heat allowed, which will effectuate such "*intention*," and yet in the same opinion the learned Judge says:

"If it were conceded that the effect of the heat, if raised to the point stated, would be to *impair the chill* of the wheel, or even to *destroy* it, I should hesitate to pronounce the Patent invalid," &c.

In stating that the *object* of Whitney's Patent was *so* to anneal the wheel as to leave the "chill" unimpaired, the learned Judge was correct. Such being the case it is only necessary to say, that if the patented process—as construed by the Court—is shown by the testimony to *defeat* that object—to destroy the "chill," the Patent lacks the element of *utility*, and is consequently void.

The record is *prolific* in testimony as to the necessity of a "chill," and a *durable* chill on car wheels, and it is asserted without fear of question on the part of any person at all conversant with the subject, that a car wheel without either a chilled periphery or a steel tire in substitution thereof, could not be sold except at the price of iron.

Joseph Kaye (Rec., p. 166,) testified that he manufactured an hundred wheels (strictly in accordance with Whitney's Patent) for the

Pittsburgh and Cleveland Railroad, which were *condemned* by the President of the road for being "soft in the chill."

Whitney, in his "History of the Art," a communication addressed to the Commissioner of Patents, in connection with his application for his extension, and offered in evidence by his Counsel (Rec., p. 79,) says:

* * * * * * "The first wheels used on railways in England were at the mines, where both rails and wheels were made of wood. The change from wood to iron was simultaneous for both rails and wheels, and both were at first made of cast iron; these first cast-iron wheels were made in the usual way of casting iron in *sand* moulds; they did but little service; the *tread* (rim) being *no harder than any other part, a groove was soon worn in the same* by the action of the rail upon it, so that, *being soon destroyed itself*, the wheel thus *defective injures the rail* by spalling off the edges."

Further quotations from the testimony, if indeed any were important as to the necessity of preserving the "chill" unimpaired, are deemed unnecessary.

We return now to the direct consideration of our second proposition, to wit: that Whitney's Patent describes and claims a process that is useless and pernicious, and the Patent is consequently void, which, as stated, involves (A) a question of law, the construction of the Patent, and (B) a question of fact, to be determined by the testimony.

(A) In the consideration of this proposition, it is necessary, as the first step, to ascertain the precise extent and character of the claim of Mr. Whitney.

Upon this point we claim that the Letters Patent are to be interpreted in a liberal spirit, so as to give the inventor the benefit of whatever invention or discovery he has made, without seeking to discover technical defects; but at the same time, if the language employed by him, in its natural interpretation, describes an invention which the testimony shows to be *useless*, then a forced construction is not to be placed upon the language of the Patent so as to make it cover a process which the testimony shows to be *useful*.

The alleged invention of Mr. Whitney being for a process of "annealing and cooling cast-iron car wheels," *i. e.*, *heating* and cooling cast-iron car wheels, by removing them, while yet hot, from the moulds in which they are cast, and then immediately placing them in a hot annealing oven, and there forthwith re-heating them, it was of course important and necessary that the *degree* to which the wheels should be re-heated in the annealing oven should be communicated by the Patentee. Not that the Patentee is required to ascertain and communicate

with exactness the degrees Fahrenheit to which the wheels should be heated, but should ascertain and communicate *about* the heat required.

It is admitted that if the Patentee mentions a degree of heat at which, or at *about* which the required result will be attained, he is not to be confined absolutely to such degree, but may nevertheless practise his invention, using a different degree of heat, and may prosecute another who uses a different degree of heat, by which the same result substantially is attained. But while this is admitted, it is at the same time insisted, that if to know the degree of heat is at all important, and the Patentee mentions a degree, or *a range of degrees*, as being proper and productive of the result desired, when in fact such a degree, or *range of degrees*, would positively injure the wheel, his Patent is for this reason void. For instance, we will suppose the wheels are 1200 degrees Fahrenheit when placed in the annealing oven; that the Patentee then tells us the wheels should be re-heated to about 2500 degrees Fahrenheit; that experiment shows the effect produced by 2500 degrees Fahrenheit to be beneficial; in this case it is admitted that if a higher or lower temperature than that named would produce substantially the same result as 2500 degrees, Mr. Whitney could properly claim them both. But, on the contrary, if he tells us that about 2500 degrees is the heat required, and experiment shows that 2500 degrees would ruin, or seriously impair the wheel, then is his Patent void, for the obvious reason that it is left to the party practising the invention to discover by experiment the proper degree of heat, and when so discovered, it would be his invention, and not that of the Patentee.

A more *liberal* interpretation of the Patent than is thus conceded will, it is apprehended, scarcely be claimed on behalf of Mr. Whitney. Now what are the requirements of the Patent as to the degree of re-heating to which the wheels are to be subjected in the annealing process? On the subject, says the Patentee:

"Be it known that I, Asa Whitney, of the City of Philadelphia, and State of Pennsylvania, have made a new and useful *improvement* in the *process* of manufacturing cast-iron railroad wheels, and I do hereby declare that the following is a *full* and *exact* description thereof:"

* * * * * * * * * * *

"As soon as they are deposited in this furnace or chamber, the opening through which they have been passed is closed, and the *temperature of the furnace or chamber, and its contents*, gradually raised *to a point a little below that at which fusion commences.*" * * * * * * * * *

"By this process all parts of each wheel are raised to the same point," &c.

This language is substantially repeated in the claim: "*say a little be-*

low that at which fusion commences;" and in these two sentences we have all that is contained in the Patent on the subject.

Edward S. Renwick, being interrogated upon this point, testifies as follows, to wit:

"+Q. 14. The next step in the process of the Complainant, as described in his Letters Patent, after the wheels are deposited in the furnace and the opening through which they have been passed is closed, is raising the temperature of the furnace and the wheels gradually to a point *a little below that at which fusion commences*, is it not?

"A. The mode of practising the process described by the Complainant is to raise the temperature of the furnace and wheels as stated in the question, but I do not understand that the specification restricts the temperature to which the wheels are raised to a point a little below fusion, *but that that temperature is one at which the effect which he desires to obtain by the increase of temperature will be attained*; the temperature must be such, as stated in another part of the Patent, *that all parts of the wheel may be raised to the same point.*

"+Q. 15. What, as a scientific man, do you understand by the words in the Patent, 'say a little below that at which fusion commences?'

"A. I understand a temperature a little below that at which the materials of the wheels would begin to melt; the expression conveys to my mind the idea that it is the highest temperature to which the wheels might be raised without risk of melting them, or a heat below that at which the wheels would become distorted by the iron changing its shape by a loss of its cohesive power.

"+Q. 16. When the *plates* of the wheel approximated the point of fusion, would the *hubs* and *treads* of the wheel be at a higher or a lower temperature than the plates?

"A. The *thinner* parts of the wheel would be at a *higher* temperature than the *hubs*, which are the *thicker* parts, or at the same temperature, *according to the mode in which the heat was applied.* The thicker portions of a casting absorb heat more slowly than the thinner parts, *consequently if the heat were applied more rapidly* than the thick portions took it up, the thinner portions would approximate to the point of fusion more rapidly than the hub, but if the heat were applied *gradually*, so that the heating of the thicker portion kept pace with the heating of the thinner portions, there would be no material difference in the heat of the parts of the wheel at the time the highest temperature was reached.

"+Q. 17. If the heat in Whitney's process was introduced at the instant of introducing the wheels into the furnace, would the temperature of the hubs and treads of the wheels be greater or less than the temperature of the plates, when the temperature of the latter was a little below that at which fusion would commence?

"A. The temperature of the different parts of the wheel would be substantially the same when the plates arrived at a point a little below that at which fusion would commence, *because the heat in the Whitney process would be raised gradually.*

"+Q. 34. Will you now please state whether any means are provided in the Complainant's Patent for ascertaining when all parts of the wheel are heated to the same temperature, and if you state that any such means are provided, please

refer to the language in the Letters Patent wherein such directions are contained?

"A. The Patent states, in one part, that 'the temperature of the furnace or chamber and its contents' is 'gradually raised to a point a little below that at which fusion commences; and in another part, *when speaking of the effect of this operation*, it states, 'by this process, all parts of each wheel are raised to the same temperature.' *These sentences of the Patent instruct a person practising the invention that if the temperature be gradually raised to the point indicated, the required effect will be produced.* The operator, therefore, who is accustomed to melting iron, can easily ascertain whether the wheels have arrived at the requisite point by examining his furnace and noting the color of the wheels due to the heat, and after a few examinations of this kind, in connection with observation of the time required to produce the effect with the quantity and kind of fuel used by him, and the distance to which the damper of the furnace is open, will be able to perform the process by regulating the burning of his fuel by the damper, without examining his furnace. The furnace represented in the drawings of the Patent may be examined during the raising of the temperature, by slightly lifting one side of the cover for a moment.

The proposition having heretofore been advanced on behalf of Mr. Whitney, as to the construction of his Patent, that it contemplates only such re-heating as will cause or produce an *equilibrium* in temperature of the several parts of the wheels; the answer thereto is this, viz: That he mentions no other point than "a little below fusion," when that equilibrium will be attained, and according to the testimony of his expert, Renwick, as will be seen, such equilibrium can, *at that point*, be attained only in one way, that is, by a *gradual* application of the heat, which is the method described in his Patent."*

When the wheels are removed from the moulds to the annealing oven, as is shown by the testimony, the temperature of their hottest part does not exceed 1100° or 1200° F., the fusing point of iron is stated by Daniell (cited by Major Wade) at 2786° F.; now it is respectfully submitted that any person undertaking to practise the process of Mr. Whitney, taking the Patent as his chart, would re-heat the wheels to say 2500° or 2600° F.

I pass now to the consideration of the second sub-division of the proposition—(B): The *effect* of Whitney's process, as patented, upon the "chill" of the wheel, which is a question of *fact* to be determined by the testimony.

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* When I come to discuss the question of infringement, I will endeavor to show that Mowry's process is the very *antithesis* of Whitney's, and consists in *retarding* by the charcoal the cooling of the *plates*, while the cooling of the hotter and thicker parts, the *hubs* is accelerated by the current of air passing through them.

Assuming 2500° or 2600° F. as the requirement of Whitney's Patent, as to the re-heating, I claim and shall endeavor to show, that the testimony conclusively establishes that a re-heating within 1000° of that named will so injure the "chill" as to render it worthless for all purposes of a car wheel; and further, that Whitney, discovering this fact in attempting to practise his patented process, has abandoned said process.

This being deemed a most important point in this cause, and also being a question wholly of fact, I propose here and now to quote all of the testimony *pro* and *con* that is contained in the record upon the point.

THE "CHILL."

George H. Thacher—Re-Examination.

"Q. 1. Do you understand the process of annealing described in Mr. Whitney's Patent, and if yea, in your opinion, could that description be followed in the annealing of chilled cast-iron car wheels, without destroying the chill or injuring the texture or fibre of the wheel?

"A. I understand it; if the process, as described and claimed by him, was strictly followed, I believe it would utterly ruin the chill of the wheel and materially diminish its strength. I do not believe that Mr. Whitney has ever conformed to his own process as claimed."

Re-cross-Examination by Complainant's Counsel.

"Q. 1. At what stage of Whitney's process, as claimed by him, the same being strictly followed, would the chill of the wheel be utterly ruined, and its strength materially diminished?

"A. When, after its being removed from the mould, and placed in his heated oven, its temperature is raised to a point a little below the point of fusion. It cannot be removed from the mould till it has cooled hundreds of degrees below the point of fusion, and the re-raising of the temperature to near the point of fusion would re-disturb the particles of the iron and the texture of the chill.

"Q. 9. Do you understand Mr. Whitney's claim to involve as a necessary *stage in his* process the raising of the temperature to a point a little below fusion?

"A. If he carries out the entire process as described in the claim, I do understand it. I think he uses and must use, in order to make a good wheel, only a part of his process; that in proportion as he raises the temperature above what existed in the wheel at the time of placing it in the pit or oven, in that proportion he injures the texture of the wheel. I believe that the sooner the wheel can be cooled consistently with an equalization of its tension the better it will bein every respect."

George S. Bosworth.

"Q. 6. From your experience of forty-one years in iron founding, and your experience of fourteen years in superintending the car wheel manufactory of Mallory & Ingalls, as stated above, what in your opinion would be the effect upon a chilled cast-iron car wheel, if it were taken from the moulds as soon after being cast as it could be moved with safety, or before it had become so much cooled as to produce any considerable inherent strain between the thin and thick parts, and putting it in this state into a furnace or chamber that has been previously heated to a temperature as high as that of the wheels when taken from the moulds, and as soon as it so deposited, the temperature of the furnace or chamber, and the wheel gradually raised to a point a little below that at which fusion commences?

"A. I think, sir, it would have a tendency to draw the chill.

"Q. 7. What would be the effect of such a process, and what do you mean by drawing the chill?

"A. The effect would be to soften the chill, that is what I think it would do. I mean by drawing the chill, taking the hardness out of the iron which has been formed by the chilling process. I think the temper can be taken out of a chill just as much as out of steel.

"Q. 8. State whether you have ever made any experiments to test this matter, and if you shall answer yea, then state what those experiments were.

"A. My experiment was all an accidental experiment. It was a piece of car wheel going through the cupola without melting except a little of one end; it was dropped to the bottom of the cupola, and laid there in the hot coals all night. That drew the temper out of the wheel. By the temper, I mean the chill of the wheel, so that the chill part of the wheel, that which had formerly been chilled, was filed—could take a file and cut right into it. You can't file into the chill part of a wheel no more than you can into steel; you may mark it, and that is all you can do."

Lysander A. Orcutt.

"Q. 6. Would the *effects* of the two processes (Mowry's & Whitney's) upon the wheels be similar, in your opinion?

"A. The effects would be quite different, so far as the chill is concerned; effecting the equalization of strain they would not be unlike.

"+Q. 24. Wherein?

"A. Mr. Whitney's process, if carried out as set forth, destroys the chill of the wheels; while Mr. Mowry's process would not impair the chill at all. Respecting Mr. Whitney's I know that such is the case. I have broken up many hundreds of his wheels that have been in use, and I have found frequently no chill in some parts of the wheel, when it was evident from the deep chill in other parts, that the chill had been destroyed by the application of heat, and that if Mr. Whitney raises the heat to a point just below fusion, and maintains it there for thirty minutes, I think the chill would be so far destroyed as to admit of turning, drilling, or filing with ordinary tools. I have tried many experiments myself in taking out the chill in a forge fire, and have never failed of destroying the chill in a very few minutes, without any indications of the iron melting."

William Clough.

"Q. 14. Please explain what kind of a degree of heat you allude to in your last answer, as being a degree which would destroy the chills.

"A. I do not mean fusing heat, but a degree of heat approaching fusion, or more definitely, a degree which would reduce the iron to a semi-plastic state. I think the chill would be modified and impaired, though perhaps not entirely destroyed at a temperature even less intense than that which would impart plasticity to the metal, say a high white heat.

"Q. 20. What, in your opinion, would be the effect upon the chill of a wheel, if after being placed in the annealing furnace, it was raised 'to a point a little below that at which fusion commences.

"A. The effect would be to destroy the chill. In this connection I desire to say, that when I have referred to Mr. Whitney's process in this deposition, I refer to the process as practised by him at his manufactory in Philadelphia, except in cases when the Patent or the process described in the specifications is under consideration

"+Q. 16. As a practical man would you, from the examination of Mr. Whitney's Patent, infer that his purpose was to destroy the chill upon the rims of car wheels, or to preserve that chill and prevent the inherent strain resulting from the cooling of wheels cast with it?

"A. I should not understand his purpose to be to destroy the chill, but should regard his process as involving great risk of destroying it."

"+Q. 17. You have said that 'if the wheel were kept for a long time at a white heat, the chill would be impaired.' How long a time would be necessary for this purpose?

"A. The effect would be gradual, commencing upon the surface, and it might require some weeks to effect the reduction of the entire chill.

"+Q. 18. What is the depth of the chill upon a car-wheel casting?

"A. The depth usually aimed at is about three-eighths of an inch. Practically it varies from a quarter to three-quarters of an inch.

"+Q. 19. If car wheels are taken from the moulds and placed in a pit, the temperature of which is raised to a point 'as high as practicable, without melting or fusing the metal,' and then suffered to cool gradually—the entire process being completed in three days—would you say that the chill of the wheels would be modified or impaired by such process?

"A. Yes. It would be practicable to raise the temperature of wheels to a point below fusing, at which the chill would be destroyed almost instantaneously. It would, however, be a nice point to attain.

"+Q. 20. Do you understand this to be the process described in Whitney's Patent—by the use of the words 'a point a little below that at which fusion commences?'

"A. I do not think Whitney contemplates destroying the chill, but the language of his Patent implies distinctly the raising of the temperature of the wheels to a point which would destroy the chill."

Robert Guyunn.

"Q. 12. You will now please to state what would be the effect upon the "chill,"

if the car wheels were heated to 'a point a little below that at which fusion commences?'

"A. The effect would be to deteriorate the chill, to how great an extent I am unable to say, never having experimented upon that point, but reasoning upon the conceded fact that like cause produces like effect, this result must be inevitable, that is, the deterioration of the chill, because if long kept in a degree of heat near the fusing point, the whole wheel would be converted into malleable iron, as is demonstrated in the process of the manufacture of that material. If this process, long continued, will produce that effect, then it follows that a shorter continuance would produce the same effect in a less degree."

Edward S. Wayne.

"Q. 14. What would be the effect on the 'chill,' if the wheels were heated to a point a 'a little below that at which fusion commences?'

"A. I am satisfied it would be destroyed. I am also satisfied that any re-heating of the wheel in a pit or oven beyond the temperature at which it was when placed there, would result in injury to the chill.

"Q 15. State whether or not you have made any experiments to ascertain the effect of heat upon chilled cast iron, and if so, describe the nature of such experiments, and the result obtained?

"A. I have, and have found that a continued heat much below that of incipient fusion, continued even for ten or twelve hours, would perfectly destroy the chill.

"Q. 16. State what degree of heat you mean by a degree 'much below that of incipient fusion;' give the difference in degrees?

"A. The heat I applied was a bright red heat. I should think the temperature did not exceed 1200 or 1300 degrees Fahrenheit. Incipient fusion would be from twenty-five to twenty-seven hundred Fahrenheit.

"Q. 26. Examine the piece of iron now shown you, marked 'Respondent's Exhibit, number 9,' and if you know, state what it is?

"A. It is a piece of cast iron with the chill upon it. It is a portion of iron taken from the cupola previous to casting the wheels to determine the extent the chill may be produced upon it. It is customary always to test the metal in this manner before casting it into wheels. The chill upon this specimen of iron was from half to five-eighths of an inch in depth. This piece of iron I placed in the crucible, and submitted it to a bright red heat in a furnace for about ten hours. It was allowed to remain in the same furnace, and allowed to gradually grow cool, which occupied about the same time. Upon testing it I find the chill is destroyed. The iron has become exceedingly soft, and may be cut with a file readily, chipped or hammered.

"Q. 27. How many degrees of heat was that piece of iron subjected to?

"A. I give it as my opinion that the greatest amount of heat that piece of iron was subjected to was from 1400 to 1500 degrees, judging from the color. At no time was it subjected to a white heat, or a point approximating to incipient fusion. The sharpness of the angles are not at all disturbed, nor has it oxidized to any great extent."

William Wade.

"Q. 7. Please state what effect would, in your opinion, be produced on the chill

of a cast-iron car wheel heated to a point 'say a little below that at which fusion commences?'

"A. It would leave the iron composing the chill in nearly the same condition it would have been had it not been chilled; the chill would be wholly or very nearly destroyed, so as to render it altogether worthless for the purpose of a chill.

"Q. 8. Please state to what degree you would raise the wheels in practising the process of annealing or cooling described in the Letters Patent of Mr. Whitney, if you were guided solely by the description and directions contained in said Letters Patent?

"A. 'A point a little below fusion' is rather indefinite; assuming Daniell, who gives about 2786 degrees Fahrenheit as being the fusing point of cast iron, I would raise the wheels, by the direction of Mr. Whitney's Letters Patent, to about 2600 degrees Fahrenheit—and I may add, that raising them to this point would be 1200 or 1500 degrees more heat than would be necessary to destroy the chill. I have no doubt at all that 1500 degrees of Fahrenheit would destroy the chill in a cast-iron car wheel."

While Major William Wade is probably personally known to each member of the Court, by reason of his long connection with Ordnance Department of the Army of United States, it is proper to say that probably no one in our country has a higher or more extensive reputation for accurate knowledge, both scientific and practical, in all branches of metallurgy; and his testimony in this cause, which it is hoped the Court may carefully read, will, it is believed, fully justify the reputation which he enjoys.

Joseph Kaye—Foreman "Fort Pitt" Works.

"Q. 7. Please state what, in your opinion, would be the effect produced upon the chill of a cast-iron car wheel, if the wheel were raised to a degree of heat, say 'a little below that at which fusion takes place,' and the same was then allowed to cool gradually in the space of three or four days?

"A. Unquestionably the properties of the chill treated in such a manner would be wholly destroyed, which I know from various experiments made by me to determine the matter.

"Q. 8. Please state any experiments you have made to test the effect of heat upon the chill of car wheels; describe the same fully, and give the results of your experiments.

"A. In the year 1849, I think it was, Mr. Totten, one of the proprietors of our Works, obtained from Mr. Asa Whitney license to manufacture cast-iron car wheels by his patented process.

"I was at that time furnished with a copy of the Letters Patent of Mr. Whitney, with drawings and patterns for the ovens and wheels, furnished by Mr. Whitney, and strictly in accordance with these I manufactured an hundred wheels for the Pittsburgh and Cleveland Railroad, which were shipped to Ravenna, Ohio, some

four months afterwards; these wheels were condemned by the President of the Road for being soft in the chill.

"We had a lot of wheels in the yard of the same kind, made at the same time, of the same iron, and in the same manner. The President of the Railroad, Mr. Prentice, with Mr. Charles Knap, one of the proprietors of our Works, came to me and informed me of the chills being soft. I thought this could not be, as I had broken one every day while we made them to see the chill, which always appeared to the eye to be good. I immediately took these gentlemen to the yard, and caused one of the wheels, taken from the stock promiscuously, to be broken, which had the appearance of a good chill so far as could be detected by the eye; after reflecting and conversing on the subject, it occurred to my mind that the heat applied in annealing the wheels might have had some effect on the chill, when I at once procured a file, and was surprised to find that the file readily cut the chill on the wheel. We broke four new wheels at the time, in all of which the chills presented a good appearance to the eye, but were all readily cut by the file. I also at the same time took a chisel and chipped easily the chills, right on the face of the tread. We at the same time tried the stock of wheels in the yard, and found all of them could be readily cut by the file or chipped with the chisel, some of them being a little harder than others.

"Afterward I made a peep-hole so that I could see into the furnace, which I heated only to a very dull red heat, then placed the wheels in the furnace, shut the damper and allowed the wheels to cool slowly; which modification and contrivance improved the quality of the chill, with now and then a cracked wheel at the top of the pile in the furnace.

"We made about 2000 wheels by this process, when, finding it impossible to produce a good wheel with the chill unimpaired, we abandoned the manufacture by this process. A few days after the experiments made with Mr. Prentice and Mr. Knap, I attracted the attention of Major William Wade to the case of the chills being destroyed in the wheels, and with him re-tested them by cutting with a file and chipping with a chisel, and together we sought to ascertain the cause of the destruction of the chill.

"To this time, so far as I am informed, scientific and practical men were ignorant of the fact, that a heat less than fusion would destroy a chill in cast iron. My attention had not been attracted to that before, nor have I ever met with any one who was acquainted with the fact prior to that time.

"I at once began experimenting, and witnessed a series of experiments planned by Major William Wade, with a view to test the effects of heating and cooling cast iron in various ways, with special reference to their strength, hardness and density of the metal, which experiments clearly demonstrated that the hard chilled character of cast iron would be removed by heat less than fusion, not greater than a bright red heat, since which time I have a thousand times demonstrated the same fact in my daily business in various ways."

Edward S. Renwick.

"+Q. 23. What, in your opinion, would be the effect upon the chill of the wheel if all parts of it were raised to a temperature, say a little below that at which fusion commences?

"A. If the temperature after being so raised was then lowered, I do not think there would be such a change in the chill as to affect its value for practical use, but if the temperature were maintained at that point for a considerable space of time the hardness produced by chilling might be materially affected; and I have no doubt it would be materially affected if, at the same time, *air containing free oxygen* were permitted to act upon it, as chilled iron under such circumstances changes its character by the burning out of the carbon contained in it."

(*Observations*—The *time* occupied by Mr. Whitney in conducting his process is, as stated in his testimony, "about three days"—record, p. 70, folio 136. Again: In Mowry's process, "air containing free oxygen" is constantly supplied to the annealing oven during the continuance of the process.)

Henry Snyder—Foreman for Whitney since 1847.

"+Q. 4. State whether these wheels in the annealing pit or furnace are heated to a point say a little below that at which fusion commences?

"A. I don't think we heat them up as high as that; *we only keep them at a red heat.*

"+Q 5. What is the result of your observation as to the effect upon the chill where they are heated to a point *at all approaching* or *anywhere near* that at which fusion commences?

"A. If that question is as to the effect, if you heat them up to a soft state, you draw the chill out; *if you heat a wheel to near fusion you draw the chill out We don't want to heat them any hotter than a cherry red.**

"+Q. 6. State how much hotter, if any, they are made than when taken from the moulds?

"A. We let the heat operate in there to equalize the heat of the wheel to take the strain off. We make them hotter, that is, the *rim* and *plate*, but I cannot say how much; I mean I can't tell in degrees. We have to determine this by practice."

It is respectfully, but confidently submitted that this testimony does conclusively establish the correctness of our proposition, that Whitney's process would destroy the "chill," and that he has, as shown by the testimony of his foreman, Snyder, for that reason abandoned it. All of this testimony was before his Honor, Judge Leavitt, when the cause was submitted to him, and yet the learned Judge states in his opinion:

"It is hardly necessary to refer at length to the evidence offered by the Defendant, to prove that car wheels annealed strictly according to the process claimed

* "Q. 18. Please state what number of degrees Fahrenheit are represented by iron heated until it exhibits the color known as 'cherry red?'

"A. Between ten and eleven hundred degrees Fahrenheit, I believe. (Wayne's testimony.")

and described in the Complainant's specification, would be so far deprived of their chill as to render them useless.

"There are several witnesses who state it as their opinion, that if the wheels are raised to a temperature when placed in the furnace, a little below the point of fusion, the chill would be impaired or wholly destroyed. *These opinions, however, are based on mere speculation*, and not the result of actual experiments in annealing car wheels. Some of these witnesses have evidently misunderstood the claims of this Patent. One seems to suppose it requires the wheels to be heated to "incipient fusion," and another speaks of them as in a "semi-plastic" state. Both are evidently mistaken as to the calls of the Patent in this regard.

"One witness—Renwick—a very learned expert called by the Complainant, gives it as his opinion, on his, cross-examination, that if the wheels when placed in the furnace were subjected to a long-continued heat, a little below the point of fusion, the effect would be to seriously impair the chill."

While entertaining the highest respect for the judicial opinion of Judge Leavitt, the writer cannot but express the belief that he wholly misapprehended the testimony in this cause, and the testimony has been quoted *in extenso*, in order to justify the opinion hereby expressed, and to show the error of the Court below.

If any doubt exists as to the destruction of the chill by Whitney's process, and the abandonment by him by his process, in view of the testimony offered it at the original hearing, such doubt must be removed by the testimony of Whitney and his extension record, offered and produced in the proceedings before the Special Master.

In his testimony, taken December, 1869, Mr. Whitney, being inquired of as to the degree of heat employed in the process as practised by him, says (see record, p. 330):

"*We aim to raise the temperature of all parts of the wheel up to that of the hottest part of it when taken from the mould.*

"+Q. 19. What is the hottest part when taken from the mould?

"A. The hub—the thickest part.

"+Q. 20. About what degree of heat have the hubs when removed from the moulds to the annealing ovens, as practised by you?

"A. That I can't tell. We have no instrument to measure the temperature. We never attempted it, except by the appearance of the wheel to the eye.

"+Q. 21. Do you not know that it is *hundreds of degrees* below the fusing point?

"A. My answer is the same as to the preceding question; we cannot measure the temperature; we never attempted it."

Extract from Whitney's Extension Statement (see record, p. 370, folio 716, and p. 373, folio 720), *showing*

both the importance of the chill, and that his process, as patented, destroyed it.

"The trials made *in the manner described in the schedule attached to the Patent* were satisfactory so far as the soundness of the *theory* upon which the improvement rested was concerned, but *practically* it *was shown that the furnaces or chambers were defective*, rendering great care necessary in their attendance.

"There was found to be *too much heat applied to the two or three lower wheels in the pile*, and *not enough to the top ones*. Those at and near the bottom *were exposed to a temperature so high*, or *so near the point of fusion as to destroy or impair the chill*; and the temperature of those at and near the top was not raised high enough to relieve them from the strain acquired; while the object desired was accomplished on the residue of the pile, those wheels being relieved from all inherent strain, and the chill not being injuriously affected by the heat they had been exposed to."

* * * * * * *

"*It is true, the chill may be impaired or entirely destroyed by raising the temperature in the annealing chambers too high. This occurred more frequently while we used the first set* of annealing chambers than subsequently, *although it occasionally happened* in the use of the *second set*, less frequently in the *third*, and never in the *fourth set*, now in use. Some of the first of these overheated wheels that escaped detection by the inspection they were subjected to, were put in use; *they, of course, performed very little service.*

"The fact, however, that they were so *injured* by the annealing process was extensively used by our competitors as a confirmation of the truth of their prediction in the premises, *until more than half the term for which the Patent was granted had expired, and we had expended more than $50,000 in erecting successively improved structures to accomplish* the object aimed at."

All this from Mr. Whitney now, but not even a *precautionary signal* held out in his Patent.

III. Mowry's process does not infringe Whitney's Patent.

This proposition, as well as those already considered, of course involves mixed questions of construction and of fact.

If the interpretation of the District Judge is to be adopted—

"I am clear that the Patent may be regarded as claiming by the fair import of the words, '*a little below the point of fusion*,' such a degree of heat as is necessary to effectuate the intention of the inventor."

It is scarcely worth while to discuss the proposition; for this is about equivalent to a declaration that we are to seek for the "intention" of

the Patentee *dehors* his Patent, and not in the Patent itself; and that, too, when the Patent is sought to be defended on the ground that it is based on a "*discovery*" made by Whitney, as to which there was no prior knowledge; and entertaining the belief, however, that such rule of construction will not be adopted by the appellate tribunal, I shall briefly consider the question of infringement.

The witnesses who have testified that Mowry's process infringes Whitney's, are

Knight, Sellers, Dougherty, Lewis, Whitney, Geo. Whitney, Asa Whitney and Renwick.

Of these it will be found, on an examination of the evidence, that *Knight alone* had seen the process of Mowry, and that the testimony of the others upon the point under consideration is based on Knight's description of Mowry's process solely, or on such description, together with Mowry's Patent. The argument or reasoning of Mr. Knight will be found in his affidavit of March 28, rec. p. 14. and is this.

After stating that he has read, and understands, Whitney's Patent, and referring to the liability of wheels to fracture, he says:

"The defect alluded to had been sought to be remedied by the *ordinary process of annealing*, in which the heat incident to casting is retained by an envelope of sand or other slow conductor.

"This, as is well known, proved inadequate, and it is believed that Mr. Whitney, in his process thus patented, was the first to effect the complete annealing of the car wheel *without impairing the 'chill'* or the strength of the wheel."

* * * * * * * * *

"The *object* and *effect* of Mowry's process is to *anneal the body of the wheel without injuriously affecting the chill of the flange or tread*, and while it differs from Whitney's in some non-essential points, is, in all essential particulars, identical with that patented by Whitney. Thus, Whitney, finding that in his vicinity the most abundant fuel of a suitable character was the slow-burning anthracite coal, arranged his furnace for active combustion previous to depositing his wheels. Mowry, on the other hand, employing the quick and intensely burning charcoal, finds it necessary to leave his fuel to be ignited by the first red-hot car wheel deposited in the pit.

"Although Mowry's pit may be cold, or nearly so, immediately preceding the insertion of the first red-hot car wheel, *yet the instant that the wheel touches the bed of charcoal it is enveloped in a body of flame and incandescent matter but little inferior in heat to the furnace in Whitney's illustration*, and being the first inserted and traversed by all the subsequent emanations of combustions from the superadded layers of charcoal, the desired effects are secured in their full efficiency. As for all the wheels afterwards inserted, they are manifestly in an already heated furnace."

The argument of the other witnesses above named is substantially the same as that of Mr. Knight.

The witnesses who testify that the process of Mowry is substantially different from that of Whitney are *Thacher, Bosworth, Orcutt, Green, Wade, Kaye, Wayne, Bromley, Clough.*

Of these, Green, Wayne, Bromley and Clough testify from personal and careful inspection of Mowry's process, and Thacher for a time conducted a process which is stated in Whitney's bill to have been substantially similar to Mowry's, and Orcutt conducted a series of experiments on wheels similar to Mowry's process.

It would extend this argument beyond all reasonable limit to insert the testimony of these several witnesses on this point. Green—Mowry's foreman—(see record, p. 138,) testifies that Knight's description is materially inaccurate, and specifies the particulars wherein it is so; this is confirmed by Clough (see record, p. 178, folio 347-8, and p. 182, folio 355).

The result of the testimony of all these witnesses is, that in Mowry's process, while the charcoal may raise the temperature of the plates of the wheels to some extent (*it being only applied to the plates*), yet practically its effect is only to *retard* the cooling of the plates; that the current of free air which is constantly passing through the *hubs* of the wheels accelerates the cooling of those parts, and the contiguity of the *rims* to the walls of the pits hastens their cooling.

The testimony of Orcutt—record, p. 136, A. to Q. 11, *et seq.*—detailing certain experiments conducted by him to determine the temperature in a process, which he says was similar to Mowry's, is deemed important, and attention is invited to it.

The only language in Whitney's Patent indicating the degree of heat required, be it remembered, is a point "*a little below that at which fusion commences*;" now, should it be assumed that there is a re-heating of the wheels, or any parts of them, in Mowry's process, it is impossible in the nature of things that with a current of cold air constantly passing through the hubs, the draft being caused by a connection with the main chimney, the wheels being placed one upon the other so as that the hubs shall coincide with each other, the charcoal being confined to the plates, and the air for its combination finding its way only between the horizontal faces of the hubs, the combustion taking place, as the Patent says, in "72 hours, more or less"—in practice, not sooner than two days, as Green testifies—"all we aim to do is to just keep the charcoal alive"—I say it is incredible that any such re-heating is, or could possibly result in such a process as is contemplated in Whitney's Patent. And how it

is possible for Mr. Renwick, who fails to discover in the processes for annealing glass, kettles and other castings, where the articles are described as being kept in a state "*approaching fluidity*," the degree of heat required by Whitney's Patent, and yet to find such degree in Mowry's process, the writer fails to comprehend.

In conclusion on this point I have only to say, that the unanswerable argument to the alleged infringement is, that if Mowry had employed such heat as would have made him an infringer, he would thereby have ruined his wheels, as is conclusively shown by Whitney's confessed abandonment of the process patented to him by reason of its ascertained injurious effect.

On the 7th Aug., 1849, there was granted to one John Murphy a Patent (a copy of same is found on pp. 306–8, rec.,) for a mode of cooling car wheels, which consisted in encasing and protecting from the air all parts of the wheels except the hubs, and causing a current of cold air, by means of connection with the main chimney, to pass through the hubs, thus retarding the cooling of the plates and speeding the cooling of the hubs. This Patent was extended for seven years from Aug. 7, 1863.

The claim of the Patent is for

"the mode of cooling, and thereby regulating the contraction of chilled railroad car *and other wheels* and *pulleys*, with solid hubs, by the application of a stream of cold air to the hub, in the manner above described, in combination with the non-conducting case for retarding the cooling of the rim as herein set forth."

The record shows that Mowry was a licensee under this Patent, and it is obvious that Mowry's process is covered by it. This process, moreover, is the very antithesis of Whitney's and Mowry's process, differing from Murphy's only in retarding the cooling of the plates by so much greater degree than Murphy's, as due to the slow burning of charcoal upon them, cannot but also be regarded as the antithesis of Whitney's, the very *essence* of which consists in heating the wheels until all parts of them have attained the same degree of heat, "a little below fusion."

This, as stated, was impossible in Mowry's process, and it is equally true that the second stage of Whitney's process as described—the slow-cooling part—is not found in Mowry's.

As to this part of his process, Whitney says: * *

"Gradually raised to a point a little below that at which fusion commences, *when all the avenues to and from the interior are closed*, and the whole mass left to cool *no faster than the heat it contains permeates through and radiates from the exterior surface of the materials of which it is composed.*"

On the contrary, in Mowry's process the avenues to and from the annealing pit are not closed at any stage of the operation; the current of cold air is constantly passing through the hubs, not only while the charcoal is burning—about 48 hours, as Green testifies—but after its combustion and during the time when there is no extraneous heat applied to the wheels, which is about 48 hours longer; the wheels being removed from the pit in about four days, as the testimony shows.

Sabbaton having testified—record, p. 120—as follows:

"Q. 6. State whether any other mode or process of prolonging the time of cooling was used by you than that described in your last answer?

"A. When the castings would admit of it, they were placed in the dump of the cupola, which partially annealed them, and by suffering them to cool gradually, would have the effect of preventing them cracking. The dump of the cupola was hot coals out of the cupola, and the heat applied to the wheels was very great.

"Q. 7. State what condition the wheels were in with reference to heat when they were put in the dump of the cupola, and describe the form of this dump?

"A. The castings were taken out of the moulds as hot as convenient, as they could be removed safely, and placed in a situation so that the hot coals from the cupola would cover them up. This dump was merely a hole in the ground in front of the cupola. The wheels were generally left there over night until morning."

Renwick was examined by the Counsel for Mr. Whitney relative to such process, specific reference being made in the questions addressed Renwick to Sabbaton's answers to questions 6 and 7 above quoted, and having testified that the same differed from Whitney's process, he, on cross-examination, says (record, p. 119):

"A. It is based upon the belief that in such process there would be practically no raising of the temperature of the wheels, and that the *cooling would not be regulated*, or *be slow enough* to permit every part of the wheel to cool and shrink simultaneously. Even if there were a raising of the temperature of the wheel (which I do not believe), the raising could not be such as to produce the effect required by the Whitney process, because the means described are insufficient for such purpose; but even if the required effects were produced, *the regulation of the heat in cooling* required by the Whitney process would not be obtained by the Sabbaton process, as there are no means provided for such purpose, and the matter is left to chance.

Now where in Mowry's process is found the "regulation of the heat in *cooling* required by Whitney's process?"

Not at all, except the current of air, and this is the very thing that Whitney expressly provides against.

Mowry, therefore, did not re-heat as described in Whitney's Patent, nor did he slow-cool, as therein provided.

His process, whether considered as an *entirety*, or as to its respective parts, was substantially different from, and did not infringe, as is respectfully submitted, Whitney's Patent.

N. G. Green Testifies—Record, p. 138.

"Q. 4. State whether or not you have read and understand the description of the Mowry process as contained in the deposition of George H. Knight, filed in this case, a copy of which is now shown you, and whether or not said description is correct, and if nay, point out where it differs from the process actually used at Mowry's Car and Car Wheel Works?

"A. I have read and do understand the said deposition. The said description is not correct in all respects. The proportion of the wheels to the size of the pit, as therein given, is not correct. The wheels in actual practice just fit into the pit, so as to pass into position without opposition from the sides of the pit, so that they will naturally slip down easy. In the next place, he represents charcoal as being covered all over the wheel. Our process is, to put in about a third of a bushel, laid around upon the plate of each wheel between the hub and the rim, and no coal upon the outside between the wall and the rim. There is an inch and a half difference between the diameter of the wheels and that of the pit and we watch it to prevent coal getting between the wall and the wheel. If any does get there we have a hook to pull it out. In Knight's description he says: '*After the insertion of the first wheel, and in fact, immediately upon such insertion, the furnace starts into active operation, and all the wheels after the first are manifestly inserted in an already heated furnace.*' And he says again: '*Although Mowry's pits may be cold, or nearly so, immediately preceding the insertion of the first red hot wheel, yet the instant the wheel touches the bed of charcoal, it is enveloped in a body of flame and incandescent matter, but little inferior in heat to Whitney's illustration.*' In Mowry's process the charcoal does not ignite—not one-half—before the second wheel approaches it. The walls of the pit are not but a very little warmed until the pit is filled. The draught is entirely shut off while the wheels are pitting, so that the coal does not ignite much. After the pits are filled with the complement of wheels, there is a cover that fits on top of the top layer of charcoal, and another cover is placed. All we aim to do is to just keep the coal alive. The coal does not all get fully ignited for several hours after the pit is filled.

"Q. 5. What is the relative heat of the different parts of the wheel, when placed in the Mowry pit?

"A. The hub is the hottest, and the inside of the rim is second; the plate is the coolest.

"Q. 6. When the pit is filled, how do the contained wheels cool?

"A. They cool faster at the hub and treads than they do in the plate, on account of the cold current of air rapidly passing through the eye of the wheel, and the cold walls of the pit taking the heat from the tread; the charcoal being slowly ignited on the plate of the wheels, keeping the plate a little warmer than the tread, allows them to cool together; by so doing it relieves them from all strain.

Wm. Wade Testifies—Record, p. 161.

"By the method of Mr. Mowry, the castings are placed in a cold pit, and the temperature of the castings is not thereafter increased, but are permitted to cool down more rapidly. The equal cooling of the casting is promoted by a current of cold air passing through the centre of the hub, which accelerates the cooling of that massive part. The cooling of the rim, which is a thick part, is hastened by its near contiguity to the cold wall of masonry which forms the pit. The cooling of the intermediate part between the hub and the rim, which consists of thinner plate or disc, is retarded by the ignited charcoal which is placed upon it. If these means of hastening and retarding the cooling of the several parts of the casting are duly proportioned to the varying masses of metal to be cooled in each part, all of the parts will cool down simultaneously, so that the temperature in each and all the parts of the casting will be equal in all the stages of its progressive cooling.

"The effect on the quality of the casting caused by Mr. Whitney's method will be, that the high temperature to which the casting is raised (assumed to be about 2600 degrees, the melting point being 2786 degrees,) will destroy the hardness of the chill, will increase the bulk, and consequently diminish the density of the metal, and will lessen the strength of the casting. The inherent strains which are caused by unequal cooling of different parts of the same casting, will be prevented by this method of annealing, but the strength and durable wear of the wheel will be thereby greatly diminished.

"By the method of Mr. Mowry, the original depth and hardness of the chil caused by the iron part of the mould in which the wheel is cast, will remain unimpaired, because the temperature of that part of the casting is not increased after it leaves the mould. All the parts of the casting being cooled equally, inherent strains will be prevented, and the wheel will thereby retain all the strength and hardness due to the material of which it is composed."

Joseph Kaye Testifies—Record, p. 167.

"A. In my opinion the processes are very different, both in the principles involved and their mode of operation and the effect produced. Both processes, in one respect, produce the same effect, namely: both prevent the wheel from rupturing in cooling. In doing so the Whitney process makes all parts of the wheel soft, diminishes the specific gravity of the iron to a greater degree, and of course weakens it. The Mowry process does not increase the heat of the wheel, does not diminish the specific gravity of the iron, does not soften the wheel in every part, does not impair the chill, but rather improves it, by permitting it to cool gradu-

ally, and more rapidly than the plate; the tread and flange being nearer to the cold walls of the pit which absorb the heat very rapidly, are cooled faster than the other parts, thereby perfecting the chill, which was first created by the same principle of more rapid cooling. In the Mowry process, unlike the Whitney process, the current of air accelerates the cooling of the hub, which, if caused even in the smallest degree, will be beneficial in relieving it from inherent strain and retaining the strength of the iron.

"The Whitney process is nearly allied in principle to that used in cooling heavy ordnance by us some years ago. We then attempted to secure all the heat in the gun pit and retain the same for the longest possible time, it having no other way of escape than through the earth. A gun of ten tons' weight, cooled in this way, in the space of ten days would be ruptured after being fired, with the ordinary service charge, between two and three hundred times.

"The Mowry process is analagous to that now used by us in manufacturing ordnance, wherein we pass a current of cold air or cold water through the bore of the gun, accelerating the cooling of the central portion and retarding the cooling of the outside, so that all parts, in the end, may be cooled simultaneously and alike. By this process we cool a gun of ten tons' weight in four days, which will bear the strain imposed by firing from 1000 to 1500 rounds with the ordinary service charge."

In the case of *Burr* vs. *Duryee* (1 Wallace, 581,) the Supreme Court say:

"It is plain that this interpolation of an abstract generalization, to render the specific description of the concrete machine more elastic, was suggested by an examination of the Boyden machine.

"If the same construction be given to the claim of Taylor, as it would necessarily invoke in a contest with preceding inventions to save it from the charge of being too broad, the Boyden machine would be properly pronounced as no infringement; on the contrary, such a construction of it as would include the Boyden machine, would make it void for being too broad.

"It matters little on which horn of this dilemma the case be put, the result must necessarily be the same."

The paragraph above quoted has a peculiar and special application to this cause.

In the contest between Whitney's process and prior annealing processes, the words of Whitney's Patent, "a little below the point of fusion," are construed to mean just what they say: on the contrary, to protect the patented process from the charge of being destructive of the "chill," the plain language of the Patent is ignored, and the words quoted are construed as contemplating, "such a degree of heat as is necessary to effectuate the intention of the inventor;" while, again, to make out a case of infringement, an "abstract generalization" is indulged in by the witnesses for Mr. Whitney, whereby the Patent is

made sufficiently elastic to comprehend any and every process wherein extraneous heat is applied, without reference to degree or mode of application.

If the same construction which is invoked on behalf of Whitney, for the protection of his Patent as against prior processes, is adhered to, Mowry's process, as is respectfully submitted, must be regarded as being the antithesis of Whitney's, and consequently no infringement of Whitney's Patent.

ARGUMENT FOR THE APPELLANT TOUCHING THE SUBJECT OF DAMAGES OR AMOUNT OF RECOVERY.

In the first branch of his report—record, p. 261—the Master states the aggregate number of wheels made and sold by the Defendant during the interval of time when he employed the process complained of, to wit: 19,819 wheels; he then states the aggregate cost of said wheels, to wit: $321,327 64; he then states the aggregate of profits derived by the Defendant from the sale of said wheels, to wit: $91 501 86, $19,984 21 interest. Total, $111,486 07.

To this branch of the report exceptions were taken on behalf of the Defendant—appellant—as follows: (record, pp. 265, 268.)

First. It is not complete; the Master has stopped short of the ultimate inquiry. He has found the total profits derived by the Defendant from the manufacture and sale of 19,819 wheels, in the making of which the Complainant's improvement was employed, but has made no apportionment of such profits.

Second. If the Master, in that branch of his report under consideration, intends to report $91,501 86 as the amount of profit realized and made by the Defendant, by reason of the application by him to said 19,819 wheels, of the Complainant's improvement, then is the objection urged, that such finding is contrary to and unsupported by the testimony.

The testimony shows:

1st. That the application of the Complainant's process of re-heating, or annealing, in connection with prolonging the time of cooling, added to the cost of the wheels at least twenty-five cents per wheel.

2d. That no saving was made in the weight of the wheels by reason of the application of this improvement.

3d. That no addition was made to the price of the wheels by reason of the application of this improvement.

4th. That no change was made in the quality of iron used.

5th. That there was no greater demand for the Defendant's wheels by reason of the use of such improvement.

Third. This branch of the report is objected to for the further reason that the cost of said wheels is not correctly stated. (Sets forth the particulars as hereinafter set forth.)

Fourth. The testimony discloses that the Defendant had obtained Letters Patent, under which he annealed and cooled his car wheels; that he was also a licensee under the Washburn, Atwood & Murphy Patents, and had employed the improvements secured by said Patents, or some of them, in making said wheels.

This, the first branch of the report, is objected to for the further reason that no apportionment of profits has been made between the Complainant's and the other improvements used by the Defendant.

Fifth. The Defendant objects to all that part of the report which relates to interest. *First.* Because the Complainant is not entitled to recover interest. *Second.* Because the interest is calculated upon the entire profits of Defendant's car-wheel business. *Third.* Because such profits, and consequently the interest, are erroneously stated.

Assuming for the present that $91,501 86 correctly represents the difference between the cost of production and proceeds of sale of 19,819 car wheels made by the Defendant from 1861 to 1867, the relative positions of the parties may be stated thus:

COUNSEL FOR WHITNEY AND MASTER.

Counsel. How much did these wheels cost?

Master. $321,327 64.

Counsel. What did they sell for?

Master. $412,829 50.

Counsel. What is the difference between cost and proceeds of sale?

Master. $91,501 86 + $19,984 21 interest; total, $111,486 07, the interest being calculated from the first of each month from 1861 to 1867.

COUNSEL TO COURT.

We claim that Mr. Whitney is entitled to a decree against Mr. Mowry for the sum of $111,486 07, that sum being the gain and profit

derived by Mowry from the manufacture of 19,819 car wheels, in the manufacture of which was employed the Complainant's process.

COUNSEL FOR MOWRY AND MASTER.

Counsel. When did Mowry adopt the Complainant's improvement?

Master. About April 1st, 1861.

Counsel. Prior to that time, was Mowry a manufacturer of car wheels; if so, by what process, if any, did he anneal them or prolong the time of their cooling?

Master. "*Prior to the time of the adoption by the Defendant of the Complainant's improvement*, he, the Defendant, prolonged the time of cooling his wheels by placing them in pits covered with dry sand, in some cases using air-tight pits without any sand; placing the wheels in the pits and allowing them to remain there four or five days; that by reason of such treatment they were finished and made ready for the market, and without further treatment were sold." (Record, p. 271.)

Counsel. Was the cost of producing the wheels decreased by reason of the employment of the process complained of?

Master—Record, p. 260—"On account of the charcoal and extra labor, the cost of the annealed (re-heated) wheels so manufactured was on the average twenty-five cents per wheel more than the cost of the same wheels without the use of the charcoal, or the re-heating process, would have been."

Counsel. Did the process complained of add to the price of the wheels or increase Mowry's business?

Master—Record, p. 263:

"The Defendant, prior to the first of April, 1861, and without the use of the process complained of in this cause, had built up his business to its then condition.

"The use of the process complained of in this cause did not diminish, but did increase the cost of making the wheels manufactured by the Defendant, as set forth in Finding No. 2, in the original report herein.

"The 19,819 wheels manufactured and sold by the Defendant, by the use of the process complained of in this cause, had they been manufactured by the use of the process adopted by the Defendant prior and up to April, 1861, and been sold at the prices which they actually did bring, would have yielded the Defendant a profit of $4,754 75 greater than the profit he did in fact realize from the manufacture and sale of said wheels.

"The Defendant did not, when he began the use of said process, nor afterwards, while he continued its use, make any difference in the quality of iron used for the manufacture of car wheels, nor in the weight or form of car wheels, nor by reason of the use of such process in their price.

"The Defendant was unable to discover that his business was increased by the use of said process; that it was with a great deal of difficulty that he introduced the annealed wheels; that the railroad companies purchasing from Defendant preferred the old wheels—that is to say, those manufactured by the Defendant prior to April, 1861—for one or two years after the new annealed wheels—that is to say, the wheels annealed by the process complained of in this cause—were first introduced, and that since the Defendant has been enjoined in this cause, and has abandoned the use of the process complained of, he has had the same customers, (excepting the Little Miami and the Columbus and Xenia Railroad Companies, and it does not appear that said companies have withdrawn their custom on account of said abandonment), and has sold the wheels he has since manufactured without the process complained of, as readily as those manufactured by use of said process, and at the same *prices*.

"Since the Defendant abandoned said process complained of, he has manufactured a wheel called the Washburn wheel, more properly called the Atwood wheel, not exactly after Washburn's Patent, but in a modified form—*the same in form* as *before* and *during the infringement*—using pits made of iron, sunk in the ground—taking the wheels from the mould at the same degree of heat as in the process complained of in this cause, placing them in the pits without any fuel, covering the pits up, leaving the wheels in four or five days; then taking them from the pits, and allowing them to cool in the open air."

PROPOSITIONS ON BEHALF OF APPELLANT.

1. The manufacture of a cast-iron car wheel is a succession of processes, consisting of, *First*, The mixing of the iron, having reference to the proper proportion of iron possessing the property of receiving a "chill." *Second*, The melting, stirring and pouring of the metal, having reference to the duration of the operation and the *temperature* of the metal when poured. *Third*, The formation of the wheel, having reference, both to the

configuration of the wheel, and the character of the *mould* in which it is cast, the same being composed in part of iron and in part of sand. *Fourth*, The removal of the wheel from the mould, having reference to temperature. *Fifth*, The *prolongation of the cooling* of the wheel, having reference to uniformity of contraction and proper adjustment of its particles, so as to prevent inherent strains, and secure, as nearly as possible, the ultimate strength of the casting.

2. Each one of the foregoing steps and processes is important in the fabrication of a useful car wheel; each of the above, Mowry, as a manufacturer of wheels, employed, for ten years prior to the date of the alleged infringement, the prolongation of the cooling being effected, as the Master reports, by placing the red-hot wheels in pits and retaining the heat as long as possible.

3. Whitney's *invention* does not extend to either of the above processes, but consists in engrafting upon the fifth process above—the slow cooling, the element of re-heating. This combining with the old thing, the slow-cooling of the wheel, the new element—the re-heating—comprehends the sum total of the Complainant's "improvement."

4. Mowry's infringement *began* when he added re-heating to slow cooling, and *ended* when he ceased to re-heat and resumed slow cooling.

The use of the re-heating element determining the *fact* of infringement, the inquiry is, what proportion of his aggregate profit was due to, or derived from, the use of such element.

"The grant to Whitney is, *in terms*, for an *improvement* in annealing and cooling cast-iron car wheels."

His Patent, in terms, *disclaims* the "ordinary" method of annealing. His witness, Knight—record, p. 39—testifies:

"This result Whitney discovered he could accomplish, so as more perfectly to anneal the wheels without materially impairing the chill, by the use of external heat, over and beyond the heat of the wheel; *the previous* mode of *annealing* the wheels having been to prolong the cooling of the wheels, merely by heating sand or other slow conductor around them."

His witness, Sellers—record, p. 48—testifies:

"The advantage to be derived from *prolonged cooling* was known previous to the application by Mr. Whitney, so far as is still customary in all founding operations; as, for instance, covering up with sand or other non-conducting material, and in some instances moulds have been enclosed in cases to prevent the too rapid passing off of the heat."

* * * * * * * * *

"Q. In your opinion, then, is that part of Mr. Whitney's process of taking the castings at a red-heat from the moulds, and placing them in a previously heated chamber or pit, for the purpose of prolonging the time of cooling, simply new?

"A. I do not think that that in itself is a novelty, irrespective of the temperature to which the pit has been previously heated."

His witness, *George Whitney*—record, p. 67—testifies to another method of slow-cooling practised prior to the Patent, that is, leaving them in the mould in which they were cast until they had cooled.

***Lobdell*—record, p. 131—testifies:**

"We have certain pits arranged, over which we have machines for hoisting them in and out, and constructed so as to retain the sand around the wheels; when these are full, as is sometimes the case, we place them on the flat and cover them up with a larger quantity of hot sand, thereby retaining the heat in the wheel, or wheels, and prolonging the time of cooling.

"By this process, the different parts of the wheel cool at the same time, consequently there is no strain or tension on any part of the wheel, and the wheels are strong and durable."

Referring to Lobdell's testimony at the original hearing of the cause, *S. S. Fisher Esq.*, Counsel for Mr. Whitney, said (extract from his printed argument, p):

"If he, Mowry, does not think, as his Counsel have argued, that there is any thing in Whitney's idea of *re-heating*, let him adopt Lobdell's dry-sand process, or some other that is obviously different from ours," &c.

"Here, it will be observed, in relation to this claim, that two things are claimed, and everything else is disclaimed.

"First. The re-heating of the wheel to be annealed, and that re-heating in connection with the slow-cooling process, which slow-cooling process was known before in the history of the arts.

"The *re-heating* is that which is claimed to be new, and which this Court has found heretofore to be new; this combination of the *re-heating* with the *old thing*, *the slow-cooling* of the wheel."

(Opinion of Mr. Justice Swayne and Judge Leavitt in this cause—record, p. 272).

With the foregoing finding of the Master before the Court, at the hearing of October 21, 1868, the Court, in the opinion already referred to, after a clear analysis of Whitney's Patent, add:

"Viewing this subject in this light, it does not seem to us that there "is anything in the case, any fact or feature, which should take it up "from the rule laid down by the Supreme Court, and which stands "unshaken, in the case of Seymour *vs.* McCormick (16 Howard)."

* * * * * * * * * * * *

"There is proof in the case that car wheels annealed in modes known "in the history and application of the art, otherwise than by the mode "involved in the invention of the Plaintiff, have a market value; that "they have been sold and used. But upon this subject the proof is not "clear or full, nor by any means conclusive, nor has the Master categori-"cally reported upon this particular point.

"All this is preliminary, as it regards this view of the subject and this "proposition. If the proof were, that when the wheels were made up to "that point—when they are to be subjected to some annealing process—"if the proof were that the wheel, at that point, was worthless—had no "actual or market value—was worth nothing to the maker, and could not "be of any value to him until subjected to the process covered by the "Plaintiff's Patent, then, perhaps, and I use that word upon reflection; "then, perhaps, it might be said that if the wheel had no value before "being annealed according to the process of the Plaintiff, and after being "so annealed its value involved a particular amount of profit, more or "less; perhaps it might be said the entire amount of profit made by the "manufacture of the wheel was due to the process of the Plaintiff, and "that, therefore, would be the standard and measure for the recovery of "damages.

"Now the Master, as I understand, has not presented the case in this "aspect. Irrespective of this particular aspect we have no hesitation in "saying that this is a case proper for the apportionment of damages.

"But it seems to us that it might as well be claimed that the Plaintiff "was entitled to the entire profit of the running gear, other than the wheel, "or upon the entire car, involving the running gear, as well as the body of "the car, as the entire profit made upon this wheel."

Following the delivery of the opinion above quoted from, the Court recommitted the case to the Master, with instructions: "To take further testimony, and report to the Court what proportion, if any, of the profit made by the said Defendant, was due to the use by him of the Complainant's invention, and that in connection with this subject he report—

"*First.* Whether the wheels made and sold by the Defendant had, or could have been made to have, any market value without being subjected to the process patented to the Complainant.

"*Second.* If they had, or could have been made to have, such value, by any annealing, or slow-cooling process, outside of the Complainant's Patent, how much additional and greater market value, if any, they derived from being subjected to said patented process.

"It is further ordered that said testimony shall be taken within sixty days from the time of the entry of this order, that the said Master shall file his report within forty days thereafter, and that either party may file exceptions within thirty days thereafter, and this cause is continued."

Now what was the response of the Master to the inquiries thus addressed him?

Prefacing his report with the statement—

"To the first proposition submitted by the Court to the Master—to ascertain and report to the Court, 'what proportion, if any, of the profit made by the said Defendant was due to the use, by him, of the Complainant's invention;' the Master reports that no testimony has been offered to enable him to make an apportionment of the total profit derived from the manufacture by the Defendant of the nineteen thousand eight hundred and nineteen cast-iron car wheels, referred to by the Master in the first finding of his original report herein, so as to credit a portion to the material used, and to the processes employed in their manufacture up to the time of their removal from the moulds, and the remainder to the processes of re-heating and slow cooling, and the Master is therefore unable to report any division of profits.

"The Master finds that the wheels aforesaid could have been removed from the moulds and finished without being subjected to the re-heating process.

"1st. By placing them in pits as soon as they could be handled, covering them with hot sand, and thereby slow-cooling them.

"2d. By placing them in like manner in pits without any fuel, covering the pits, leaving the wheels in the pits, and thereby slow-cooling them.

"The Master finds that wheels so manufactured have, and did have from April

1st, 1861, to April 9th, 1867, a market value equal to that of wheels manufactured by the use of the process complained of in this cause."

Again:—"I find that wheels of the material, size, shape and weight of those manufactured by the Defendant, could have been manufactured without the use of extraneous heat, and at less cost, by either of the methods described in finding V. of this report, and that wheels so manufactured would have had the same market value, in the market where the Defendant sold said 19,819 car wheels, as if extraneous heat had been applied to them as described in the Complainant's Patent, or as used by the Defendant."

These findings, together with all those hereinbefore quoted, are confirmed by the Court in the final opinion and decree, and yet the entire profits of Mowry's business, "as estimated by the Master," are awarded to Mr. Whitney.

In the final opinion the learned Judge alludes to and quotes the admission of the Counsel for Mr. Whitney, made at the hearing on the merits, that *re-heating* was the invention of Mr. Whitney, that his claim is for that new element in *combination* with the old element, slow-cooling, and that slow-cooling *alone* would be no infringement of the Patent; after which the Court continues:

"It has since been, and is now claimed by the Complainant, that the "Patent covers not only the re-heating and slow-cooling in *combination*, "making the entire process described, but also the several parts of "the process taken separately, including slow-cooling without re-heating, "as where slow-cooling alone is used by the alleged infringer. On the "other hand, I understand it was claimed before the Master by the "Defendant, that the Patent is to be so construed as to limit its effect to "re-heating, and that if the Defendant used slow-cooling in connection "with re-heating, as described in the specification, he is to be held liable "only so far as his profits are shown to have been increased by the "element of re-heating. To this view of the subject I cannot accede. "Whatever else the Patent may be for, it is clearly for the process "desoribed as an *entirety*. All the wheels to which the Master's account "relates were finished by both re-heating and slow-cooling. This brings "the case clearly within the Patent.

"I do not deem it proper to consider open any question which was "foreclosed by my learned brother in settling the decree by which the "case was referred to the Master, whether slow-cooling without re-heating "is covered by the Patent, and whether the Patentee was the original "and first inventor of that process, as applied to car wheels, are inquiries

"wholly outside of the case, and not necessary to be considered in its "proper determination."

In the paragraph quoted we have the entire argument of the Court on which the final decree is based, and it consists in this, to wit: Whitney claims re-heating in combination with slow-cooling, making an *entire* process. Mowry used, as the District Judge has decided, this entire process, and hence infringed; it matters not, therefore, whether or not slow-cooling was old, or, in other words, whether Whitney's *invention* extended to both re-heating and slow-cooling, or only to re-heating, since his *claim* extends to the *combination* of the two elements, and Mowry used both.

The error of the learned Judge in this case is precisely that of the Circuit Court, which was reviewed and reversed by the Supreme Court in *Seymour* vs. *McCormick*, and is susceptible of various illustrations, for instance:

A represents a vibrating needle bar carrying an eye-pointed needle. *B* a horizontal table, for the support of the material to be sewed. *C* a reciprocating shuttle, carrying the under thread.

Wilson invents another element, *D*, say an improved "feed," which he patents, claiming as his "improvement" *A*, *B*, *C* and *D*, in combination.

In this case Wilson's claim is for *four* elements in combination, just as Whitney's claim is for *two* elements in combination. Each claim, therefore, is in the same sense for an "entirety," and the manufacturer who adds element "*D*" to *A*, *B* and *C*, is brought "clearly within the Patent."

But in such case, in a suit for infringement on such Patent of Wilson, shall he take from the infringer all the profits made in the manufacture of the sewing machine as a *unit*, or only such profits, if any, as have been derived by the infringer from the engrafting of element "D" upon the other elements, A, B and C.

If the employment of element "D" adds one dollar to the commercial value of the machine, its cost of production remaining the same, there is clearly profit derived by the infringer, *by reason of the infringement*, in just that amount, less the cost of production of element "D;" but, *per contra*, if element "D," while adding to the cost of the machine as a unit, does not add to its commercial value, shall Wilson receive from a Court of Equity the profits of the infringer's business, not as derived from, but as reduced by the infringement?

The illustration employed is in all respects parallel with the case before the Court. Mr. Whitney not being able to show that he has sustained any *damage* directly, asks for a decree on the basis of Mowry's profits.

An account is taken under the order of the Court.

Now suppose the Master had reported thus:—"Mowry, prior to 1861, slow-cooled his car wheels in pits without extraneous heat, and the wheels so made cost $10 00 each and sold for $11 00, leaving him a profit of $1 00." He commenced the use of the process complained of, that is, employed extraneous heat, April, 1861; the wheels to which his improvement was applied cost $10 25 each, and sold for $12 00. In this case we have an added cost by reason of the "improvement" of $0 25, and an added commercial value of $1 00, showing a net profit of seventy-five cents per wheel, directly traceable to the infringement, and this sum, upon such state of proof, I apprehend, would be adopted as the measure of profits and the basis of recovery.

But, *per contra*, when the Master reports that the adoption of the "improvement" by Mowry increased the cost of his wheels and did not increase their selling price, nor increase his business, on what rule of law or principle in equity can the Court, while confirming such report, award to Whitney the enormous sum of $125,000?

It has been remarked that the Court below erred in the same manner as did the Circuit Court in the case of *McCormick* vs. *Seymour* (3 Blatchf., p. 256).

The parallelism is perfect in the two cases: say the Court in that case—

"It has been suggested by the Counsel for the Defendants that inas-
"much as the claims of the Plaintiff in question here are simply for
"improvements upon his old reaping machine, and not for an entire
"machine and every part of it, the damages should be limited in pro-
"portion to the value of the improvements thus made, and that there-
"fore a distinction exists in regard to the rule of damages between an
"infringement of an entire machine and an infringement of a mere
"improvement on a machine. I do not assent to this distinction. On
"the contrary, according to my view of the law regulating the meas-
"ure of damages in cases of this kind, the rule which is to govern is
"the same whether the Patent covers an entire machine, or an improve-
"ment on a machine. Those who choose to use the old machine have a
"right to use it without incurring any responsibility; but if they engraft
"on it the improvement secured to the Patentee, and use the machine

" with that improvement, they have deprived the Patentee of the fruits " of his invention the same as if he had invented the entire machine, " because it is his improvement that gives value to the machine on " account of the public demand for it. The old instrument is aban- " doned and the public call for the improved instrument, and the whole " instrument, with the improvement upon it, belongs to the Patentee. " Any person has a right to use the old machine, and if an inventor " engrafts upon an old machine, which he has a right to use, an im- " provement that makes it superior to anything of the kind for the " accomplishment of its purposes, he is entitled to the benefit of the " operation of the machine under all circumstances, with the improve- " ment engrafted upon it, to the same degree in which the original " inventor is entitled to the old machine."

* * * * * * * *

" When you have ascertained the aggregate sum of the cost, deduct " it from the price paid by the purchaser, and you have the net profit " on each machine.

THE OPINION OF THE SUPREME COURT, IN REVIEW OF THE FOREGOING CHARGE: 16 HOWARD, 480.

P. 487. " The Plaintiffs in error co nplain that these rules, with regard " to damages, as thus laid by the Court, are incorrect, and have produced " a verdict for most ruinous damages, far beyond anything justified by " the facts of the case.

" 1. Because the jury were instructed that it is a legal presumption, " that if Defendant had not made and sold machines, all persons who " bought the Defendant's machines would necessarily have been compelled " to go to the Patentee and purchase his machines. That this principle " was enunciated as a binding principle of law, although the Plaintiff " below had given no evidence to show that he could have made and " sold a single machine more than he did, or was injured in any way " by the competition of the Defendants, or hindered from selling all he " made or could make.

" And, *secondly*, because the jury were instructed that the measure " of damages for infringing a patented *improvement* on a machine in " public use, is the same as if the Defendant had pirated the *whole* " machine, and *every improvement on it previously made*, and as a con- " sequence, that the Plaintiff below had a right to recover as great dam- " ages for the infringement of the Patent in his second count, as if he " had proceeded on both counts of his declaration, and shown the in- " fringement of all the Patents claimed, and that in consequence of

"these instructions, they have been answered in damages to the enor-
"mous sum of $17,306 66, and with costs to nearly the round sum of
"$20,000.

"*We are of opinion that the Plaintiffs in error have just reason of*
"*complaint as regards these instructions and their consequent result.*"
* * * "But one who invents some improvement in the machinery
"of a mill, could not claim that the profits of the whole mill should be
"the measure of damages for the use of his own improvement." * *
* * * "Where an inventor finds it profitable to exercise his
"monopoly by selling licenses to make or use his improvement, he has
"himself fixed the average of his actual damage, when his invention
"has been used without his license. * * *
* * * "*It is only where, from the peculiar circumstances of the*
"*case, no other rule can be found, that the Defendants' profits became*
"*the criterion of the Plaintiffs' loss.* Actual damages must be actually
"proved, and cannot be assumed as a legal inference from any facts
"which amount not to actual proof of the fact. What a Patentee
"'would have made if the infringer had not interfered with his rights,'
"is a question of fact, and not 'a judgment of law.'

"*The question is not what speculatively he may have lost, but what*
"*actually he did lose.*"

"It is not 'a judgment of law,' or necessary legal inference that, if
"all the manufacturers of steam-engines and locomotives who have
"built and sold engines with a patented cut-off, or steam-whistle, had
"not made such engines, that therefore all the purchasers of engines
"would have employed the Patent of the cut-off or whistle, and that
"consequently such Patentee is entitled to all the profits made in the
"manufacture of such steam-engines by those who may have used his
"improvement without his license. Such a rule of damages would be
"better entitled to the epithet of 'speculative,' 'imaginary,' or fanci-
"ful, than that of 'actual.'

"If the measure of damages be the same, whether a Patent be for an
"*entire* machine, or for some improvement in some part of it, then it
"follows that each one who has patented an improvement in any por-
"tion of a steam-engine or other complex machines, may recover the
"whole profits arising from the skill, labor, material and capital
"employed in making the whole machine, and the unfortunate mechanic
"may be compelled to pay treble his whole profits to each of a dozen

" or more several inventors of some small improvement in the engine " he has built.

" By this doctrine even the smallest part is made equal to the whole, " and '*actual damages*' to the Plaintiff may be converted into an un- " limited series of penalties on the Defendant.

" *We think, therefore, that it is a very grave error to instruct a jury* " *that as to the measure of damages the same rule is to govern whether* " *the Patent covers an entire machine or an improvement on a machine.*"

* * * " The judgment of the Circuit Court is reversed, with a " *venire de novo.*"

INSTRUCTIONS OF THE CIRCUIT COURT TO THE JURY AFTER THE FOREGOING REVIEW:—3 BLATCHF., 211.

" If the Patent is for a machine, an *entire machine*, the Patentee is " entitled to damages, in cases of infringement, to the profits he could " have made in constructing and vending his machine, *over and above* " *the mere profits arising out of its manufacture.*

" *By that, we mean the mere profits of its mechanical construction*, and " not the profits that grow out of the exclusive right to manufacture " the invention under the Patent. The latter belong to the Patentee, " while the former, *the mere mechanical profits are excluded from the* " *damages.*

" And, if the case is one of an *improvement* on a machine, then he is " entitled, as a measure of damages, to all the advantages of the use of " his patented improvement, *excluding the profits of the manufacture,* " *and excluding also the value, if any, of the use of the old machine.*

" Now, so far as respects the benefits and advantages that a Patentee " would derive from an improvement on a machine, you see, at once, " that they would depend very much, if not altogether, upon the useful- " ness of the machine with that improvement, compared with its useful- " ness without that improvement. Hence, you have found, in the " course of the trial, that witnesses have been introduced for the pur- " pose of ascertaining the relative value of the Plaintiffs' machine with " the improvements in controversy, and of the same machine without " those improvements. *If the machine, stripped of those improvements,* " *would be a useless article in the market, and if no person would buy it* " *unless those improvements were annexed to it, then its value, so far as* " *its utility is concerned, depends on those improvements, because they* " *give it vitality and usefulness in the eye of the business community.*"

The jury returned a verdict for the Plaintiff, and judgment was entered thereon in the Circuit Court, in June, 1855, for $10,348 30.

This judgment was affirmed by the Supreme Court of the United States, December Term, 1856 (19 *Howard*, 96): except as to costs, which were not allowed to the Plaintiff.

In *Burdell* vs. *Denig*, suit for infringement of Sewing Machine Patent, the Court, Swayne, J., say: * * * "As before remarked, "the Plaintiffs in making out their case exhibited a machine containing "the mechanism in regard to which the Plaintiffs have an exclusive "right, *and containing, also, many other elements of great importance, if* "*not equalling or surpassing in importance the particular mechanism* "*which was claimed by him.*

"Now, no testimony was given to show what proportion that mechan- "ism bore to the other portions of the machine, and the jury were left "to grope in the dark to reach such conclusions as they, in the absence "of the light of any other evidence upon the subject, might be able to "attain. We suppose that, in that state of case, the Plaintiffs were "entitled, at most, to nominal damages only.

"It was incumbent upon *them* to have given specific evidence to the "jury, or at least that upon which the jury would have been warranted "in forming a conclusion as to the extent and value of their claim."

* * * * * * * * *

"* * * It is well settled by the case of *Seymour* vs. *McCormick*, "that where an inventor has invented only an *improvement*, and *there* "*is a violation of his right under his Patent to use that improvement in* "*connection with the invention of others*, or in *connection with a ma-* "*chine previously known and used*, in *either* case his damages must be "*limited* to the *value* of his *improvement* in connection with the other "elements of the machine. *That is a subject in regard to which it may* "*be difficult to give definite proof; but the difficulty does not change the* "*legal principle which applies. Such proof must be given.*"

Now in the case before the Court, the "*improvement*" of the Complainant, appellee, was employed by the Defendant, in connection with slow-cooling and other processes "previously known and used," in connection also with the patented inventions of others, to wit: Atwood's, patented nearly a year earlier than Whitney's, for which Mowry, as he testifies, paid Atwood $2000 "for his Cincinnati shop right"; Washburne's, patented 1849, for which Mowry was to pay ten or twelve per cent. of the profits of his business for three years (see record, p. 286);

Murphy's, patented 1849—the consideration for the use of which is not disclosed.

The Master, in his final report, says: "To the first proposition submitted by the Court to the Master (on recommitment), to ascertain and report to the Court *what proportion, if any, of the profit made by the said Defendant was due to the use by him of the Complainant's invention.*" The Master reports that no testimony has been offered to enable him to make an apportionment of the total profit derived from the manufacture by the Defendant of the 19,819 cast-iron car wheels referred to by the Master in the first finding of his original report herein, *so as to credit a portion to the material used, and to the processes employed in their manufacture up to the time of their removal from the moulds, and the remainder to the processes of re-heating and slow-cooling.*"

Under the rule in *Burdell* vs. *Denig*, it was "incumbent on the Plaintiff to have given this specific evidence," and so also the evidence as to the value of the "improvement" of Whitney in connection with the patented improvements of Atwood, Washburne and Murphy. It may have been a problem difficult of solution, "but the difficulty does not change the legal principle which applies."

Applying to this case the rule established in *Seymour* vs. *McCormick*, and it is beyond the ingenuity of man to show that Mowry made a farthing by reason of having engrafted Whitney's improvement upon the processes as theretofore employed by him; the whole testimony proves, the Master reports, and the Court in confirming the reports decides, that the employment by Mowry of extraneous heat was an item of expense, and produced no profit, either directly or indirectly.

"The re-heating is that which is claimed to be new, and which this "Court has found, heretofore, to be new; this combination of the "re-heating with the old thing—the slow-cooling of the wheel.

"Now pursuing this line of thought and analysis, we find that rail-"road wheels are to be made of the same dimensions as before; they "are to be of the same configuration as before; they are to be made of "fused metal as before; the metal is of the same kind as before; it is "to be fused in the same manner as before; it is to be introduced into "the proper moulds in the same manner as before; the wheel is to be "completed—aside from the annealing process—in the same manner as "before; it is to be taken from the moulds in the same manner as before.

"Up to this point the process of the Patentee towards the accom-"plishment of the ultimate result is just the same as would be pursued "if the Plaintiff's process had never been invented.

"Here the roads fork, and the divergence commences. Now any

"person, irrespective of this Patent, after the wheel has reached the "point mentioned, would have the right, in consistency with this Patent, "immediately to put it into a pit—the right would exist, as I under- "stand is conceded, to apply hot sand, sand previously heated—the "right would exist to close the pit, and exclude the air, and to subject "the metal to the annealing process by slow-cooling, as the phrase is, "to such extent as this means or any other means known in the history "and practised in the art of annealing prior to that time might sug- "gest. The Plaintiff, then, availing himself of all these means and "instrumentalities, interposes, in the progress of the construction and "completion of the wheel, a new element, the right to use which "exclusively is secured to him; and that new element is simply, after "the wheel has been taken from the mould, and has been placed in the "pit, to subject it to a re-heating—a tempering which involves the "re-heating of the iron structure; and then that re-heating is to be "connected with the old process of slow-cooling. In this re-heating, in "combination with slow-cooling, lies the novelty, the utility, the vitality "of this Patent.

"*Viewing this subject in this light, it does not seem to us that there* "*is anything in the case—any fact or feature—which should take it up* "*from the rule laid down by the Supreme Court—and which stands* "*unshaken—in the case of Seymour* vs. *McCormick*, 16 Howard.

"The rule of damages is the profits which had been derived by the "Defendants from the use of the Plaintiff's machine over any other "mode which the Defendants had a right to adopt." *Serrell* vs. *Collins* (Ingersoll, J.), 1 Fisher, 289.

The correctness of the rule in *Serrell* vs. *Collins* is recognized by the Supreme Court in *The Suffolk Company* vs. *Hayden*, 3 Wallace, p. 315.

We cannot more appropriately close the consideration of the propositions which lie at the foundation of the question at issue, and which are directed to the *principle* on which the final decree of the Court was based, than by adopting the following language of the Circuit Court, as contained in the opinion of October, 1868:

"*It seems to us that it might as well be claimed that the Plaintiff was entitled to the entire profit of the running gear, other than the wheel, or upon the entire car, involving the running gear as well as the body of the car, as the entire profit made upon this wheel.*"

Whitney is estopped by his own testimony from attributing any value to his "improvement," or asserting any

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"*It seems to us that it might as well be claimed that the Plaintiff was entitled to the entire profit of the running gear, other than the wheel, or upon the entire car, involving the running gear as well as the body of the car, as the entire profit made upon this wheel.*"

Whitney is estopped by his own testimony from attributing any value to his "improvement," or asserting any

profits to have been derived therefrom, other than a *saving of metal* of ten pounds per wheel.

When Whitney applied for his extension, he was required to set forth, under oath, not only his receipts and expenditures, but, the "*ascertained value of the invention.*"

This he did after having had fourteen years of experience with it, and what does he say?—record, p. 373:

PROFITS.

"I believe there is no essential difference in the cost per pound of "making cast-iron chilled car wheels of the various patterns, and by "the different modes in use, providing the same skill and system control "the manufacture. *But by my process I am enabled to make them lighter* "than those made in any other way for a similar service, and I can, "therefore, afford to sell them at the same price *per wheel* as other ma- "kers, and *save the cost of the difference in weight. This saving of metal, "therefore, I deem to measure the essential advantage I have over my "competitors, and also the profits arising from my Patent.*

"There have been made to January 1, 1862, under my Patent, "255,640 wheels, of all sizes. From the best data I have been able to "get upon the subject, *I estimate that* 10 *pounds per wheel would be a "fair average of the metal saved by my process.* On the larger sizes there "is greater difference than this, but on the small sizes less."

Had Whitney, therefore, himself made and sold the 19,819 wheels that Mowry made, what profits would he have derived "from his Patent?" Saving of metal—10 pounds per wheel on 19,819 wheels—198,190 pounds; saving in money (at average price of metal paid by Mowry, as reported by the Master, $58 00 per ton) $5,450 21.

This would have been the profit of Whitney, as sworn to by him after fourteen years' experience, and an expenditure of $52,000 in perfecting his process after obtaining his Patent, and yet he would have the Court believe that Mowry, by doing that which he asserts was the same thing, made $111,000!

Whatever saving of metal Mowry *might* have effected by adopting the "improvement," the Master reports that in *fact* he effected none, not having changed the form or weight of his wheels, and so did not enjoy the sole advantage which Whitney attributes to his improved process.

In ascertaining the value of a patented invention, and apportioning "profits," reference must be had to the invention as *described in the Patent*, and not as subsequently improved upon; and Whitney's process, as described and claimed in his Patent, could not be employed, profitably, by any person.

Whitney, in his extension statement, testifies—record, p. 370:

"Prior to my Patent for annealing or prolonging the cooling of "cast-iron car wheels, I had experimented in a comparatively small way "as to the best means to be employed to accomplish the object desired. "Copies of the drawings of the first furnaces or chambers used for that "purpose are attached to the Patent. *The trials made in the manner* "*described in the schedule attached to the Patent were satisfactory so far* "*as the soundness of the theory, upon which the improvement rested*, was "concerned, but *practically* it was shown that the *furnaces or chambers* "*were defective*, rendering great care necessary in their attendance.

"*There was found to be too much heat applied to the two or three* "*lower wheels in the pile, and not enough to the top ones. Those at and* "*near the bottom were exposed to a temperature so high, or so near the* "*point of fusion, as to destroy or impair the chill;* and the temperature "of those at and near the top was not raised high enough to relieve "them from the strain acquired."

He further testifies that he expended upwards of $52,000, after getting his Patent, in erecting improved furnaces and "*ascertaining the best practical means to be employed for accomplishing the object*," and states the net result thus—record, p. 374:

Say expenses, - - - - - - -	$52,970 31
Say profits—saving of metal, - - -	38,346 00
Deficit, - - - - - - - -	$14,624 31

Now what possible profit could Mowry have made from the infringement of such a Patent as Whitney testifies his was?

Whitney, in fourteen years, lost $14,000, and yet would persuade the Court that Mowry, in seven years, by the use of the same thing, made 111,000!

Whitney having proved *no loss*, and Mowry having made *no gain*, the infringement, assuming the fact, was *damnum absque injuria*, and in no event is Whitney entitled to a decree for more than nominal damages.

The "estimate" of the profits of Mowry's business, as made for and adopted and reported by the Master, is not reliable—is inconsistent in its several parts, and with the testimony, and is calculated to mislead and deceive.

Pages 242-259, inclusive, of the record, embrace a series of tables, entitled, "The findings of George R. Sage, Master, &c., as to the numbers, sizes and prices of annealed car wheels sold by A. L. Mowry, April, 1861, to April, 1867," &c.

These tables are computations based, or purporting to be so, on testimony previously taken.

It is not supposed that the Court will undertake an elaborate investigation of these calculations, but attention is called to a few facts which can be readily examined, whereby it will be clearly seen that the "estimate" of the profits of Mowry's business, as reported by the Master, is a vast over statement.

The following facts, somewhat extraordinary as they may appear, are *unquestionable*.

1. That a comparison of the weights of the annealed wheels embraced in said tables with the weight of the iron as contained in the same tables will show, that the wheels weigh 871,355 *pounds more* than the iron out of which they were made.

In proof of this fact the attention of the Court is invited to "Schedule C"—record, p 252—where the *quantity* (*weight*) of *iron* used in the manufacture of the annealed wheels is stated, to wit: 3839 tons, 724 lbs.=8,707,506 lbs. Also to "Schedule A," p. 247, where the weight of the annealed wheels made from said iron is stated, to wit: 9,578,931 lbs. Result:

Weight of wheels, - - - - - -	9,578,931 lbs.
" " iron, - - - - - - -	8,707,506 "
Gain of wheels in process of casting, - -	871,425 lbs.

2. The *testimony*, instead of showing this remarkable result, shows a loss of metal in the process of forming the crude iron into car wheels of about ten per cent.

On the 15th May, 1868—record, p. 237—N. G. Green, Mowry's foreman, testified to such loss. This testimony mysteriously disappeared from the record from that date, until *July* 15, 1868, at which time an agreement between Counsel for Complainant and Defendant was entered into, as follows—see record, bottom of page 237:

"It is hereby agreed that the following statement is admitted as part of the deposition of Noyes G. Green before the Master, and as part of the stipulation in this behalf, dated 'Cincinnati, May 15, 1868:'"

"*Noyes G. Green says that the loss in melting and casting iron is ten per cent.; that is, a ton of iron*, 2268 *pounds, gives* 2041 *pounds of car wheels.*

"Said statement is to be deemed and taken as in evidence before the Master as of the date of said stipulation."

(Signed by Counsel.)

There was no testimony offered to affect the correctness of Green's testimony on this point.

Reducing, therefore, the quantity of crude iron reported by the Master by this ten per cent. loss, and the result is that it would yield only 7,839,962 pounds of wheels; being ***1,738,969*** pounds *less* than the weight of the wheels made from it.

In other words, the Master has understated the *cost* of said wheels by the value of the said 1,738,969 pounds, amounting, in money, at the average cost of iron during the period, to upwards of $45,000.

3. On pages 239, 240 of the record, will be found a full and complete statement, prepared at the request of the Master, by *Samuel First*, book-keeper for A. L. Mowry, and taken from his books, showing the number of *old wheels* purchased by Mowry from April 1st, 1861, to April 12, 1867, so far as entered on the books of the establishment, the statement being made out for each month during the period named, and being *minute* as to number, price per pound and aggregate amount. The witness testifying—record, p. 241—that the statement does not embrace all the old wheels purchased during the period embraced in it, "for the reason that sometimes Mr. Mowry would settle with the parties from whom purchases were made, at his office, down in the city, and return to me only a statement of the amount to be credited to those parties;" for which he thinks there should be an allowance made of 600 wheels, or 150 tons more.

He further testifies that all of these *old* wheels were used in the man-

ufacture of the *new* wheels embraced in the Master's account, except such as were used in making two lots (100 wheels), sold to Wessel in 1863.

The aggregate cost of so many of these old wheels as are included in First's factory books—record, p. 240—is stated as having been $80,313 45.

In the Master's tables—p. 249—the amount allowed to Mowry as the cost of these old wheels is $34,808 45, being $45,505 00 less than was paid for them by testimony of the highest character, and not disproved, or attempted to be, in any manner whatever.

4. In the said computations adopted by the Master there is no one year in which the *weight* account of iron on the one side, and of wheels made from it on the other will balance; in some years, for instance, 1862–1865, the weight of iron *exceeds* that of the wheels; in such years, therefore, the accountant, in the endeavor to balance the weight account, adds to the weight of the wheels "10 per cent. for loss in casting," and finding that he still has a surplus of *iron*, arbitrarily balances his account with the words "remaining to represent *under*estimate of weights" of wheels; on the contrary, in those other years, 1863–4, when the weight of wheels *exceeds* by upwards of 443 *tons* the weight of iron out of which they were made, the accountant omits to add to weight of wheels the 10 per cent. for loss in casting (which would of course increase the balance of overweight of wheels), and *arbitrarily* balances his account with the words: "Excess over total iron, showing *over*estimate of *weights*" of wheels.

Averaging the "*overestimate*" for the year 1864 among the wheels made that year, and the weight of each must be reduced by upwards of 100 *pounds*—a reduction which would render the wheel totally useless; for no one would accept it as a *gift* on condition of being obliged to use it.

While using said ten per cent. loss *in the manner stated*, in endeavoring to balance "*weight account*," the accountant does not take any note of such item in arriving at the *cost* of the wheels embraced in said computation.

A word now as to the effort that has been made since the order of October 22d, 1868, to prove invention on the part of Whitney as far back of date of his Patent as possible.

In his opinion, preceding the interlocutory degree, Judge Leavitt said:

"The Complainant's Patent bears date in April, 1848, but it appears his application for a Patent dates back to the 2d August, 1847, which is to be viewed as the date of his invention." (Page 7, printed copy of opinion.)

The Counsel for Mr. Whitney, just on the eve of the expiration of the limit fixed in the order referred to for the taking of testimony, examined Mr. Whitney as to the *date* of his invention, and Mr. Kidd shortly before having testified to practise by him of slow-cooling since March, 1847 (afterwards and at commencement of Whitney's deposition, fixed by agreement in writing of Counsel, at *May 1st*, 1847, by reason of the writer having received a copy of the deed to Kidd), he, Whitney, deems it essential to ante-date Kidd, and so, in answer to inquiry of his Counsel, testifies: * * * *

"I hired the foundry in Willow street, and commenced the manufacture of wheels in *February or March*, 1847; I cannot be sure as to whether it was February or March."

Now, in reference to this fact, as well as every other fact deemed by him or his Counsel to be material, Mr. Whitney is *self-contradicted.*

Referring to his extension record, made in 1862, when he had no object in perverting the truth, so far as *date of invention* was concerned, it will be found that he stated as follows, to wit:

"In the spring of 1847, in company with my son George, we hired a small foundry in the city, in which, early in the following *June*, we *commenced to prepare* for casting and treating wheels in the manner described in the schedule attached to the Patent referred to."

CHAS. B. COLLIER,

of Counsel for A. L. Mowry.

Supreme Court of the United States.

ALBERT L. MAWRY, Appellant.
vs.
ASA WHITNEY, Respondent,

No. 148

BRIEF AND POINTS FOR RESPONDENT.

This cause comes before the court on appeal from a final decree in equity of the circuit court of the United States for the sourthern district of Ohio, entered in August, 1870, and printed on pages 415 and 416 of the record.

The cause was argued in that court on final hearing upon pleadings and proofs before the Hon. Judge Leavitt, district judge for that district, in January, 1867, and held under advisement until April of that year, when a decree was entered, adjudging the patent sued upon valid—that it had been infringed by the appellant—and directing that it be referred to a special master, George R. Sage, Esq., to ascertain and report the gains and profits made by the appellant, and adjudging that the injunction *nisi* theretofore ordered by Mr. Justice Swayne and Judge Leavitt, sitting together, should be made perpetual. This decree is printed on pages 192 and 193.

The suit was instituted for an infringement of letters patent of the United States, granted to the respondent, dated April 25, 1848, for a new and useful improvement in annealing and cooling cast-iron car wheels, which letters were, on the 7th day of April, 1862, extended by the Commissioner of Patents for the period of seven years.

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ABSTRACT OF FACTS.

The respondent swore to his application for letters patent for said improvement July 31, 1847, and filed the same, with his specification, in the Patent Office, on the 2d of August of that year. (Record p. 76, 77, 78.) He commenced making patterns for the purpose of introducing his invention into use in 1846, but no car wheels embodying it were made until 1847. (Record, p. 69.)

The purpose of his invention was to prevent and retrieve the unequal strain to which cast-iron car wheels were subjected after being cast, and during the process of cooling. This inequality of strain, and consequent weakening of the wheel, was due to the fact, that its thin portions cooled and hence contracted in length before a like effect was produced upon the thicker parts; and hence, as the parts which cooled last shrank in the operation, they broke or struggled to break away from those which had previously cooled; and the consequence was a fractured and worthless wheel, or such strains, short of rupture, as made its use dangerous.

It appears from the proofs to have been known, prior to 1847, that slow and uniform cooling of castings tends to prevent rupture or straining; and the witnesses on both sides substantially concur in stating the methods employed in various, and generally ineffectual efforts, to attain that end in the cooling of castings.

Thus *Sabatton*, a witness for the appellant, (page 120,) testifies he followed the business of an iron founder from 1810 to 1840, and made large cast-iron wheels for guns and machinery, and that to prevent unequal shrinkage they shielded some portions, exposed other parts, and sometimes poured water upon the hub, the thickest part of the casting. These were the only modes known to him, except that on two or three occasions, as a trial, but not as a regular business, he dumped the casting when hot into a hole in the ground, and placed coals over it. This, however, was an unsuccessful as it was an abandoned experiment.

Bosworth, (p. 127,) another of the appellant's witnesses, testified he knew of no other mode of annealing iron castings prior to 1847 than that of putting charcoal around the portions which cooled quickest, that all might shrink as nearly as possible alike to prevent cracking.

Kaye, another witness for appellant, (pp. 164–165,) who swears that Totten, a member of the establishment in which he was interested, took a license from the respondent under this patent, (p. 166,) testified that he, prior to 1847, annealed *cold* castings by re-heating them, and then permitting them to cool gradually; and he also states other modes sometimes resorted to, of cooling cog-wheels, &c., in the ash-pit of the foundry.

Orcutt, another of the appellant's witnesses, the proprietor of a foundry at Watervliet, who has carried on moulding and casting since 1835, testified (p. 134) that the modes known to prolong the cooling of castings straining were, to cover their parts with dry exposing the thick parts to currents of air, a of water; at other times removing the casti mould, laying charcoal around the thin parts, igniting it, and exposing the thick parts, as before stated. This witness further states, (p. 136,) *that the only mode of cooling car wheels of which he had knowledge prior to* 1847 *was to leave them to cool in the open air, with some portion of the sand on them used in moulding.* He also states (p. 135) that he had worked in the shop where car wheels were cast in 1840; that they were split-hub wheels prior to 1847, *and that prior to that date he had never seen or heard of any process of annealing car wheels.*

Sellers, a witness for the respondent, (pp. 56–57,) and Whitney (p. 71) concur with Orcutt in his statement as to the only mode known of annealing castings or cooling car wheels prior to 1847.

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In consequence of this serious and apparently unsurmountable defect in the process of annealing and cooling car wheels prior to the invention in question, it was necessary to employ in their construction split hubs, so that, as

the metal between the rim and hub shrank, the latter, being in detached parts, would accommodate itself to the shrinkage without fracture, or, so far as practicable, unequal strain. There were great objections to these split hubs, but their makers could not, without some means of slow cooling then unknown, employ the solid hub. This difficulty is well stated by Lobdell, the appellant's witness. (p. 132.)

Efforts were made to remedy the defects of wheels containing this split hub, and several patents were granted for improvements upon them, which will be found stated in the record, (pp. 88 to 92.) Finally a patent was granted to Eddy (Record, p. 92) in December, 1845, for such a combination and conformation of plates between rim and hub as were intended to prevent the unequal cooling and shrinkage from straining the wheel; and Bosworth, a witness for the appellant, testifies, *that this was the first car wheel he ever saw with a solid hub.* (Record, p. 130.)

Now, it should be observed, that the art of casting cast-iron car wheels has long been regarded as a distinct and very difficult branch of casting, (record, pp. 59–62,) and so distinct and difficult that Bosworth (p. 129) testified, that not one man in a thousand could make a good wheel. Hence it may be assumed that this has led to the employment of persons, in that branch of manufacture, of the very highest skill, possessing the most complete knowledge of the art of casting in iron; and we may justly infer that at the date of the respondents invention, in 1847, *no known or described means* of so cooling car wheels as would enable the manufacturer to use the solid hub had been left untried.

The state of the art at the date of this invention was, therefore, just this: In consequence of this unequal cooling, shrinkage, and inherent strains, no solid hub had been or could be employed until after Eddy's invention, in 1845; and this, though probably a wheel of little or no value—certainly not in comparison with the respondents—it was practicable to make with such a hub, not because such a

process of slow cooling had been devised as to prevent unequal shrinkage, and strains between rim and hub; *not because of any improvement whatever in the method of cooling*, but because Eddy, instead of so splitting the hub as to enable it to accommodate itself to unequal shrinkage, had contrived such a peculiar form and combination of plates, as to enable them to perform, as he supposed, the same office. By this means he employed the solid hub; but whilst the former arrangement of his plates was such as to partially adapt themselves to this unequal cooling and shrinkage, without fracture in the operation, it is doubtful if this defect in the mode of manufacture, which before resided in the split hub, was not merely transferred by this supposed improvement to another part of the wheel.

Be this as it may, however, no advance was made by Eddy in improving the means to secure uniform cooling; and the fact that he struggled to accommodate *the form of the plates* of his wheel to the strains it was to receive well illustrates the fact that no mode was then known by which unequal cooling and its consequent mischiefs could be prevented *by a new method of cooling.*

In further illustration of the state of the art of manufacturing cast-iron car wheels, it should be stated, that for more than thirty years, they have been almost uniformly made in this country with chilled rims; and so well and generally has this been understood, that during all that time such mode of construction has been implied in the very mention of cast-iron wheels for railroad purposes. (Testimony of Lewis, Record, p. 62.)

The chill of the wheel, which is produced upon its periphery by forming the mould for that part of iron, whilst the other portions of the wheel are moulded in sand, is exceedingly hard, resisting the action of the file, and consequently the wear produced by the friction of the rail, for a great length of time. The action of the particles of iron forming the rim, as they are brought in contact with this cooling metal, is remarkable, peculiar crystals being thereby formed at right angles to the chilled surface, and

extending into the metal from one half to three fourths of an inch, depending upon the kind of iron used. (Record, p. 66.)

The action of the metal part of the mould necessarily cools the tread of the rim much quicker than other parts of the wheel are cooled in the sand, and consequently the shrinkage of the rim upon the arms or plates is rapid; and, as the hub, from its greater mass, is the last to cool, the shrinkage of that and the arms or plates tends to separate or weaken the connection between them and the hub or rim, as the case may be.

It is therefore indispensable to the production of a sound and strong cast-iron chilled car wheel, that means should be provided before any considerable shrinkage takes place to arrest the irregularity of shrinkage and cause all parts of the wheel to cool, and consequently contract, in harmony with each other; for thus and thus only can a perfect union of the particles of iron composing the wheel be preserved. This, as the state of the art shows, had never, prior to 1847, been accomplished; and this the respondent has completely performed by a process to which, as described and claimed by him, we respectfully ask the attention of the court.

What, then, is the invention thus described and claimed? In general terms he states it to be a new and useful improvement in the process of manufacturing *cast-iron railroad wheels*, the bare mention of which indicated wheels having chilled rims. Approaching a more particular description of his process, he states his improvement to consist in taking railroad wheels from the moulds in which they are ordinarily cast, as soon after being cast as they are sufficiently cool to be moved with safety, *and before they have become so cool as to produce any considerale strain between the thin and thick parts*, and in this state placing them in a furnace or chamber previously heated to a temperature as high as that of the wheels when taken from the moulds. He further directs that, as soon as this is

done, the opening through which they have been passed is to be closed, and the temperature of the furnace or chamber gradually raised to a point a little below that at which fusion commences, when all the avenues to and from the interior are to be closed, and the whole mass left to cool no faster than the heat it contains permeates through and radiates from the exterior of said chamber; whereby the thinnest and thickest parts cool and shrink simultaneously together, which relieves them of all inherent strain whatever when cold.

Now, it is not pretended that a cast-iron car wheel was ever before removed from its mould, placed in a heated chamber, and there subjected to a process of slow cooling, for the purpose of preventing inherent strains. It is said that instances are proven of other castings having undergone similar treatment; but without here pausing to show diversities between such treatment and the process of the respondent, it is enough to say that its application, or the possibility of it, or the means and method of its application, to cast-iron car wheels was before utterly unknown. It is moreover not denied that the process, as described by the respondent, will accomplish precisely what he states it will; that is to say, simultaneous cooling and shrinkage of all parts of the wheel, and relief from all inherent strain.

It should here be borne in mind that the specification of a patentee is directed to persons skilled in the art to which his invention relates. If such persons can, by following its directions, practice the invention, it is sufficiently described. Now, it was well known in 1847 that nearly all car wheels then in use were cast with chilled treads. They were thus made much more durable, although not more strong or safe.

The great value of the chilled tread was then thoroughly appreciated; and as this was caused by its being suddenly cooled by the iron portion of the mould, thereby adding to the inequality of shrinkage, and therefore to the strain, such an improved process of cooling was demanded as

would meet the emergency, by securing uniform cooling from the time when the chill should be adequately formed. All this was well known to the respondent. His process was not intended to be confined in its application to the cooling of a car wheel with an unchilled tread. It was designed to prevent the very shrinkages and strains which the production of the chilled tread aggravated; and whilst it was equally applicable to produce the same result in the cooling of cast-iron wheels not possessing this peculiarity, it is absurd to suppose that, in dealing with this subject, the respondent, a skillful car-wheel constructor, well acquainted with the history and practice of that branch of the art, should not have adapted his process to the uniform cooling of the only car wheels then in practical use. That he, in fact, did this is proved beyond all question, not only by the specification and by the nature and capacity of the process therein described, but by the testimony of those by whom it has been practically employed.

Thus *Redfield*, the inspector of car wheels in the establishment of Whitney & Son, testifies, (pp. 84, 85,) that he has inspected over 80,000 wheels cooled by this process, having chilled ~~bands~~ treads, and that not two in a thousand are defective from imperfection in the chill; and not even that proportion from want of strength and toughness; and he adds, that in these instances the defects arise from improper management of the fires.

And *Snyder*, another witness, foreman of their foundry, and of course thoroughly acquainted with the process of casting and cooling, testifies, (p. 85,) that he has been such foreman since May, 1847; that the respondent's process does not affect the chill, and that they sometimes work a month without destroying the chill of a wheel, when, if they fire-up too strong, they destroy one or two. He added that, in practice, they heated the wheels to a cherry red; that they usually made them hotter than when taken from the mould, but how much in degrees he could not tell, this being determined by practice. (p. 87.)

POINTS.

I. In view of this state of facts, and of the specification, what is the invention described and claimed by the respondent? It is, in general terms, the described process of so applying heat to the wheel, after it is taken from the mould, that its further cooling shall be arrested, its heat increased, if need be, to such a point short of fusion, and, of course, short of destroying the chill, as will retrieve the strains already produced by unequal cooling, if any there be; and from that point so retarding the cooling of the wheel, that the heat of each part shall subside in unison with that of every other part, thereby producing the result stated in the specification.

(1.) The specification is directed to persons skilled in casting car wheels, and, of course, those having a chilled tread. This chill is complete so soon as the wheel is sufficiently cooled to be removed from the mould. This is not disputed; and the direction in the specification is, to take the wheel from its mould as soon after being cast as it can be removed with safety, or before it has become so much cooled as to produce any considerable inherent strain between the thin and thick parts.

Now, it should be borne in mind that the inventor is here ~~given~~ giving instructions which *cannot, from the nature of the subject, be so precise as to dispense with the practical knowledge and skill of the operator.* All the inventor could do in his specification was to state in what condition the wheel should be when removed, leaving the operator to ascertain this. It *cannot* be removed until it is so hardened by cooling as to maintain its shape. It *may not* be taken from the mould by the workman until it shall have cooled so much and so unequally that strains have been produced between the thin and thick parts. The instruction is to remove it before any *considerable* inherent strain shall have been produced. It is impossible—and so the inventor knew—to remove the wheel from the mould, in

all cases, at exactly the right moment. In practice, some wheels would be cooler than others when removed; and some would be more cooled than others by the very process of removal. Some would, by the unequal cooling, have been more subjected to inherent strain than others, and occasionally one might have received a *considerable* inherent strain.

(2.) To provide for all these possible conditions, and especially to secure not only the prolonged cooling—the great purpose of the process—but also such re-heating and annealing as would so expand the iron of the wheel that its thick and thin parts would again assume the position they were in before inequality of cooling had produced inherent strain, the respondent directs that it shall be placed in a furnace or chamber which has been previously heated to a temperature high enough to retrieve any strain of the wheels when taken from the mould and deposited in the pit.

Now, the purpose and value of this direction are obvious; for it is desirable that the temperature of the wheel, should not, until the process of prolonged cooling has commenced, be lower than it was before any inherent strain from unequal cooling had occurred. And it being impossible in practice either to take the wheel from the mould at exactly the right moment of time or to remove it from thence to the furnace so quickly that it will not, before being there deposited, become cooler than when thus removed, it follows, that the general direction, that the furnace should be of a temperature as high as that of the wheel when taken from the mould, is wise and practical; for as the wheel would, when deposited in the furnace, be somewhat cooler than the temperature thereof, it follows that something would be required to reheat the wheel to that point at which the desired chill and hardening of the several parts thereof in the mould had been produced. To accomplish this the inventor directs that, as soon as the wheels are deposited in the furnace, the opening through which they have been passed is to be closed, its temperature gradually

raised to a point a little below that at which fusion commences, when all avenues to and from the interior of the chamber are to be closed, and the whole mass left to cool no faster than the heat it contains penetrates through and radiates from the exterior of the surface of the materials of which it is composed.

(3.) Now every one skilled in the art of making cast-iron car wheels—every person of intelligence reading this specification with knowledge that prolonged cooling from the time the several parts of the wheel become so hardened as to retain their shape would prevent inherent strain between the thick and thin parts thereof—cannot fail to understand the purpose of these directions. The inventor knew that in practice it would be impossible to remove the wheel from the mould in all cases before some inherent strain had been produced by unequal cooling. He knew also that at the point of time when the chill had become perfected by the cooling action of the iron portion of the mould, and the other parts of the wheel were sufficiently hardened to maintain their relation and shape, no material ~~inherent~~ strain between the thin and thick parts had occurred; and this was and is known to every competent constructor of car wheels. When, therefore, the respondent, in his specification, directs the heat of the furnace to be increased to a point a little below that at which fusion commences, it is well known that his sole purpose is, by such increase, to reproduce such a condition of the wheel as existed before unequal cooling had produced inherent strains. Assuming, therefore, as the fact is, and as it is proved by the witnesses on both sides, that these strains do not commence until after the chill is completely formed, and that to retrieve the wheel from their effect it is wholly unnecessary to reheat it beyond the point at which they commence, it follows inevitably that persons skilled in making cast-iron car wheels would, in following this general instruction, be guided by their own practical knowledge as to the degree of heat to apply, and would

carry it no higher than to accomplish the avowed purpose of the inventor. Treadwell v Parrott. 5 Blatch 369

This direction is therefore to be understood precisely as it would be if the respondent had told the constructor to reheat the wheel in the furnace until its temperature should be so raised as to retrieve it from inherent strains produced by unequal cooling, but not so high as injuriously to affect the chill of the [redacted]; and thus it has been understood by all who have given a fair practical meaning to the language of the specification.

(4.) If we seek for instruction upon this point in the means described by the inventor—to reheat the wheel, and prolong its cooling—we find them to harmonize with the views already presented. The furnace or chamber described for this purpose is not of a kind suitable for reducing wheels to or near the melting point; nor without carelessness or want of skill in managing the fire, to a temperature likely to impair the chill. Thus, if we refer to the testimony of the appellant's witness, Gwynn, (pp. 147, 148,) we find that his description of a furnace suitable for melting iron is quite unlike that described by the respondent; whilst he states that substantially such a method of reheating as is set forth in the specification would neither melt the wheels nor impair the chill.

The appellant's witnesses, who attempt to show that to practice the respondent's invention as described would be to destroy the chill of the wheel, utterly disregard his avowed purpose in reheating, lose sight of the means he describes for that purpose, and wholly pervert and misrepresent the real object of his process, which, in harmony with preserving the chill of the wheel wholly unimpaired, seeks only to retrieve it from the strain it has undergone after it has become so hardened as to be fit to be removed from its mould.

In verification of this the court is referred to the testimony of Thacker, (pp. 125, 126, 127;) of Bosworth, (p. 128;) of Orcutt, (p. 134;) of Gwynn, (pp. 144, 145;) of Wade, p. 160;) who all assume that the direction to raise the tem-

perature of the cooling chamber to a point a little below that at which fusion commences is to be understood, not as an instruction to increase the heat of the wheel to such a point before slow cooling commences, that it shall be relieved from inherent strains, which, as every person skilled in the art knows, is all that is required, and precisely what the inventor intended, *but so high as to destroy the chill.* And in illustration of what they mean by this unnecessary and mischievous expenditure of fuel, *Wade*, at page 160, swears that the melting point of iron being 2,786 degrees, he would heat the wheels to 2,600 degrees; whilst Gwynn, (pp. 144, 145,) who states the melting point of iron at 2,800 degrees, says that, following the respondent's instructions, he would raise the wheels to a temperature of from 2,500 to 2,800 degrees.

Clough, another of the appellant's witnesses, also gives his views as to the effect of excessive heat in impairing the chill, and says, in substance, he thinks it would be destroyed by heating the wheel *to a semi-plastic state, and might be modified or impaired at even a less temperature than would impart elasticity to the metal.* (p. 182.)

It is unnecessary to pursue this inquiry further. It is evident that the witnesses thus testifying, in giving a construction to the words a "little below fusion," overlook or wholly disregard the context—the purpose of reheating as described—and their own practical knowledge as to the degree of heat proposed by the respondent for the purpose of attaining his object.

It is almost unnecessary to say, that all of the witnesses introduced by the respondent who testify on the subject concur fully with what is here presented on his behalf.

(5.) In further illustration of what the process or invention of the respondent, as described and claimed in substance, really is, it may be added, that it consists in removing the wheel from its mould when sufficiently hardened for that purpose, and before it has undergone such a degree of unequal cooling as to produce any considerable inherent straining between the thin and thick parts, and whilst in

that condition placing it in a furnace or chamber, so heated that its cooling below the point stated shall be so prolonged as to maintain a substantially uniform temperature throughout the thick and thin parts of the wheel until it becomes cold. When this process is substantially performed, the wheel will be sound, strong, and free from any considerable inherent strains; and to accomplish this, and thereby to employ the invention described by the respondent it is immaterial, as he says, what kind of furnace or chamber is employed, or how or by what fuel heat is imparted to it; nor is it essential that the precise directions should be followed of heating the chamber before either of the wheels to be annealed or gradually cooled shall be placed therein. If this were otherwise—if the process could be substantially appropriated, by first taking a wheel from its mould, and placing it in a cold chamber with a quantity of charcoal which would immediately ignite, and, burning rapidly, commence heating the chamber, whilst other wheels with charcoal added were being placed therein; and if this furnace with its contents could be closed, and the reheating and prolonged cooling be thus carried on without accountability to the respondent, his process could in all substantial respects be employed, his ideas appropriated, his patent rendered worthless, and his invention become the prey of every infringer who should combine with his dishonesty of purpose ingenuity sufficient to vary the form of the process whilst employing its substance.

II. The respondent was the original and first inventor of the process described and claimed.

1st. It should be borne in mind that the manufacture of cast-iron car wheels was, prior to 1848, a distinct branch of casting, the wheels being cast in chills to harden the peripheries, and therefore demanding a different kind of iron from that used in ordinary casting, as some kinds will not chill or harden as required. (pp. 59, 62, 129.)

The only mode practiced prior to the respondent's invention, of cooling cast-iron car wheels, was by placing

them in the open air, with some portion of the sand left on which had been used in moulding. (*Orcutt*, appellant's witness, p. 136.) And a careful examination of the proof will show that, for practical purposes, the only mode of prolonging and securing the uniform cooling of castings in substance was, to uncover and expose the thick parts thereof to the air, sometimes pouring water thereupon, occasionally covering the thin parts with burning fuel to prevent them from cooling too rapidly.

Appellant's proof, Sabatton, pp. 120, 121.
Bosworth, p. 127
Respondent's proof, Sellers, p. 56.
Whitney, p. 71.

2d. An effort was made by the appellant to show that castings, other than car wheels, having no chilled or hardened portion, had been subjected to processes similar to that described and claimed by the respondent, and that the same mode of prolonged cooling had been described in various patents and printed public works. It was not pretended, however, that car wheels, with or without chilled treads, had ever been subjected to any such process, or that such a method of prolonged cooling is applied to them, as had been, prior to the respondent's invention, described or patented.

Now, independent of the fact that cast-iron car wheels, as known and universally employed in and prior to 1847, were cast with chilled treads, and therefore required to be so annealed and cooled as not materially to impair that portion of the wheel; and hence, as we insist, demanding a peculiar process of prolonged cooling unlike that applicable to any other kind of casting then known, it may, upon the proof in this case, be stated with entire confidence, that no process substantially like that described and claimed by respondent, for annealing and cooling castings of any kind, was known and practiced, or had been described in any printed public work, prior to the date of his invention. The fact that prolonged cooling would secure uni-

formity of temperature between thick and thin parts of the casting, and prevent inherent strains—was known; and various methods most of them mere experiments, and applied to very small castings—had been before attempted and described for the purpose of securing that result; but these, if they did not end in experiments, were so impracticable, or so inapplicable to large castings, and especially to castings of the character of car wheels, that they proved to be of little or no value for any purpose, and were so utterly incapable of being usefully applied to the annealing and prolonged cooling of car wheels, that, as we have already seen upon testimony quite uncontradicted, the only mode actually employed for the purpose was to remove them from the mould with some portion of the sand thereof remaining upon them, and in that condition permitting them to cool in the open air. It should be remembered, too, that this, the only known practical mode of cooling them, was so utterly destructive of the relation of the various parts of the wheel, that, until a short time before the respondent's invention, the invariable practice was, to cast the hub in detached pieces; the only change from this which was attempted to prevent the effect of the unequal cooling being so to vary the form of the plates between the hub and the rim that they would change their form, and thus accommodate themselves to the unequal cooling of the metal. It was indispensable to get as strong a wheel as possible, and the only impediment to this had ever been the unequal cooling and shrinkage of the parts. It is not credible that a knowledge of any practical mode of accomplishing this could have existed prior to the date of the respondent's invention. If any such means had been known, would they not have been applied to the annealing and prolonged cooling of car wheels? They were, of all others, castings which demanded the utmost strength and freedom from inherent strains; and when, as is conceded, these strains were produced solely by unequal cooling of the thin and thick parts, can any one doubt that a process, such as that described by the respond-

ent, would, if known, have been applied, when the most skilful car-wheel constructors were struggling, by means of split hubs and concave and convex plates and other contrivances, not to prevent unequal cooling, but the mischievous, the dangerous inherent strains consequent thereupon?

(3.) If we now look at the means employed to secure prolonged cooling, relied upon by the appellant, as prior in point of time, and as substantially like those described, and claimed by the respondent, we shall find that they were almost invariably applied to castings—the strength and soundness of which were comparatively unimportant; and that, moreover, the processes thus employed were mere experiments, or utterly inadequate to ~~affect~~ effect the annealing and prolonged cooling of cast-iron car wheels.

Thus *Sabatton* (p. 120) states in substance, that he followed the business of iron founding from 1810 to 1840; that during that time he found it necessary to anneal cast-iron gun-carriage wheels, and large wheels for machinery; and that the mode employed to prevent unequal shrinkage was, to expose certain portions, shield others, and sometimes to pour water into the center of the hub. The only exception by him stated to this mode of cooling was, that he put two or three cog-wheels, *as a trial*, into a hole in the ground, in front of the cupola of the furnace, and covered them with hot coals. These were the only modes known to him, and that last described was of course but an abandoned experiment. (p. 121.)

Bosworth (p. 127) states, that the only mode of annealing known to him prior to 1847 was, to put charcoal around the thinnest portions of the castings, so that all would shrink alike.

Lobdell (p. 130) had known small pulleys to be placed in a pot of charcoal, and iron trimmings packed around them *to make the pulleys soft.* Never knew ~~that~~ this applied to large castings. It hardly need be said that this was an entirely different process from that described by the respondent, and for a wholly different purpose.

to be

That this experienced person, who used this process to soften pulleys as early as 1833, did not know how to secure the uniform cooling of car wheels is evident from the fact, that in 1838 he, with one Bush, obtained letters patent for a method of dividing the hub into two parts, and making each plate convex outwardly. (pp. 90, 91.) Exhibit R

This he found objectionable, and, about December, 1847, or January, 1848, *after the invention of the respondent*, and after Lobdell had, without doubt, made himself acquainted with it, he adopted the method of prolonged cooling, by covering the wheels with hot sand. (p. 131.) He, (on page 133,) probably fearing that this method might be deemed a substantial appropriation of the respondent's process, states that he heats the sand only enough to dry it.

Orcutt, who had seen no process of annealing car wheels prior to 1847, (p. 135,) states that the common mode of annealing castings prior to that time was, covering the thin parts with dry sand, exposing the thick parts to air, sometimes to water, and sometimes employing burning charcoal to prevent the thin parts from cooling too suddenly.

He then proceeds to state some exceptional modes of cooling castings, which, if practicable for any purpose, were utterly inapplicable to the cooling of car wheels; for he swears that, with a knowledge of these prior methods, he worked for Starbucks, in Troy, from 1839 to 1841, and again in 1843, (p. 135,) and that he there saw car wheels left to cool in the open air, with some portion of the sand of the mould left upon them, and that he recollects of no other mode of annealing them practiced, *though there were many experiments tried.* (p. 136.)

Gwynn (p. 141) states the only mode of annealing by him known to have been practiced, adding, that for annealing car wheels the dry-sand process came into vogue after the methods he first describes had been in use for other purposes, neither of which is at all similar to that described by the respondent.

He then, after stating (p. 145) *that he has had no experi-*

ence in annealing car-wheels, testifies that in his opinion he finds the respondent's process described in exhibits 1 to 7. (p. 142 to 145; Exhibits 148 to 156.)

Wade, another witness for the appellant, 77 years of age, states his experience in the casting of iron cannon, &c., and that in 1834 there were cast at his foundry, in Pittsburg, chilled cast-iron car wheels. (p. 157). His attention was particularly directed to testing the strength of the cannon, &c., and for this purpose he devised various instruments, which occupied him some ten years. The idea of retarding the cooling of castings was first suggested to him by the statement of Count Rumford, to the effect that *the strength or toughness of cast iron* depends much upon the slowness with which it cools *in the mould*. He then describes several methods of annealing, adding, not that they were employed for the purpose of securing a uniformity of temperature whilst cooling, *but in order to soften the iron* and he particularly describes the means employed to anneal a six-pounder cannon, by placing it, after being cast, in a cylinder of sheet iron larger than the exterior of the gun, and filling the surrounding space with charcoal, which was ignited, and, after being consumed, the gun was left to cool by radiation. This, as before stated, was to soften and toughen the iron, and was not designed to secure uniformity of cooling of its several parts, nor to prevent inherent strains. Indeed, this idea does not seem to have occurred to *Wade*, nor does he state at what temperature the gun thus annealed was placed within the cylinder.

The annealing, as described, was to secure toughness, not freedom from inherent strains; and this process, as well as the other modes suggested by this witness, were substantially unlike that described by the respondent.

Kaye, another witness for the appellant, well illustrates the purpose of the annealing described by *Wade* when he says, (pp. 164, 165,) that he placed wheels for cotton machinery, *in a cold state*, in a square cast-iron box, surrounding which was a coating of clay, around which a fire was built, until the box was raised to a red heat, and then suf-

fered to cool gradually. The sole purpose of doing this was to make the wheels soft and tough, not to prevent inherent strain, for to this the wheels had already been subjected in cooling. He also described cooling cog-wheels slowly, by raking coals of fire upon them in the ash-pit of the furnace. This is utterly unlike the process employed by the respondent. That which somewhat resembles it was the mode of cooling an oil-receiver, in 1847; but aside from the fact that it does not appear that this receiver was of unequal thickness, and would therefore cool unequally throughout its mass, *it is not affirmatively shown that this was done prior to July*, 1847, *the date of the respondent's application for his patent.*

The testimony already referred to is believed to be all that was relied upon by the appellant to prove that the process claimed by the respondent had been described, or was known or used, prior to the date of his invention. It is confidently submitted that it utterly fails to establish this.

Turning to the testimony of the witnesses on the part of the respondent, we learn that, prior to the date of his improvement, no process substantially like that by him described was known to the most experienced cast-iron founders, and that great and apparently unsuperable difficulties existed in so cooling cast-iron car wheels as to prevent inherent strains, but that these were entirely overcome by his process.

Doughty, pp. 58, 59.
Lewis, pp. 62, 63.
George Whitney, p. 67.
Asa Whitney, p. 71.

E. S. Renwick also testifies that the extracts from public works relied upon by the appellant, as descriptive of the respondent's process, wholly fail to describe the same, and are utterly inadequate, if reduced to practice, to perform its office. In confirmation of this, and as very persuasive proof that no process was known prior to 1847 whereby cast-iron car wheels could be so annealed and cooled as to secure uniformity of shrinkage and freedom from inherent

strains, the court is referred to the several patents mentioned in the record from pages 88 to 94, which show the efforts made by skilful and ingenious men to obviate this great difficulty; not by preventing it, but by so constructing the hub or forming the plates of the wheel that the mischief would be modified and lessened.

III. The process employed by the appellant was a palpable infringement of the respondent's patent.

(1.) It is conceded that the appellant usually removed his wheels from their moulds as soon as they were so hardened by cooling as to maintain their shape, and before they had been subjected to any considerable inherent strain. It is urged that as he placed the first wheel in a cold instead of a hot chamber, he thereby materially varied from the respondent's process; but it should be remembered that, before depositing this first wheel, there was placed in the bottom of the pit such a quantity of charcoal as the operator saw fit to use; and the moment the red-hot wheel was applied to this it ignited and commenced rapidly to heat the chamber, so that, when the second and third of the series of ten or twelve were placed therein, each red hot wheel being accompanied by its quota of charcoal, each and all, after the first and second, were thus deposited not only within a hot chamber, but in a mass of flame fully capable of reheating the wheels to the condition they were in when taken from the moulds, and no doubt to a much higher temperature, depending, of course, very much on the quantity of charcoal employed. It is true that *Orcutt* and some others of the appellant's witnesses (pp. 134, 139, 161, 167, 175) state, that by this means the wheels would not be heated to a temperature higher than when they were taken from the mould; but this is a mere opinion, opposed to probability and to the testimony of the respondents' witnesses; but if correct it would not tend, even in a feeble degree, to repel the proof of infringement; for this may consist as well in substantially employing the respondent's process as in following it out to the minutest particular. The appellant's

treatment of the wheel, from the time it is hardened in the mould until it is removed therefrom and finally cooled, is in substantial conformity to the directions contained in the respondent's specification, and occupies about the same length of time. (Clough, p. 188.) The respondent does not claim to be the inventor of any particular kind of furnace, and he expressly declares that the heat required to perform the process may be obtained by the use of other fuel or means than those by him described. The appellant employs charcoal, and to this he adapts his furnace and method of procedure; in all essential particulars, however, following the instructions of the respondent. Indeed if we assume, as we may and should, that the appellant observes the directions to be found in the patent to him issued and printed on pages 22 and 23, it is quite clear that his witnesses are mistaken in supposing that he does not raise the temperature of wheels after they are placed in the chamber; for, after stating that he has invented a method of *annealing*—a word which means *to reheat a casting gradually and permit it to cool gradually*—(Record, p. 165,) he expressly declares that his invention consists in the use of the charcoal, &c., *for the purpose of heating the wheels up to a proper temperature*, prolonging the heat, and permitting them to cool in the course of a given time gradually. He also, in his specification, refers to the modes before known of annealing and cooling cast iron, and denounces as imperfect the very methods which, in this case, are set up by him as prior to, and substantially like, the respondent's process.

Brief in support of that part of the decree which rests on the report of the master.

Before considering the exceptions taken by the appellant to the report of the master, it is important to state, that under the practice of the circuit courts of the United States, as regulated by rules made by this court, exceptions to the

report of a master must state, article by article, those parts of the report intended to be excepted to, and point out with precision what the exception is. Exceptions to the report of a master are in the nature of a special demurrer; and the party objecting must point out the specific error relied on. (Story *v.* Livingston, 13 Pet. 366.)

The 83d rule requires such exceptions to be filed, and every part of the report not specifically excepted to stands confirmed. (Brocket *v.* Brocket, 3 How. 691.)

Any general, sweeping exception, denoting nothing but dissatisfaction with the report, is a nullity. (Dexter *v.* Arnold, 2 Sumner, 103.)

The exceptions taken by the respondent below to the report of the master are found on pages 399 and 400 of the printed record. They are prefaced by a statement that the respondent excepts to each and every part of the master's report, except certain passages which are quoted. For reasons already given this exception is a nullity.

A specific exception is then taken to the following finding of the master:

"I.—If, as is claimed by complainant's counsel, the entire process of reheating and prolonged cooling, used by the defendant in the manufacture of said wheels, was an infringement upon the complainant's patent, the master finds that the total profits realized by the defendant from the manufacture and sale of said wheels, was due to the use by him of the complainant's invention."

"And the defendant excepts to finding 'I' of said report, inasmuch as it assumes that no interpretion or construction has been given to the complainant's patent by the court; whereas an interpretion had been so given, as was well known to the master, and the construction placed on said patent by the master, as the hypothesis of said finding, is directly in conflict with the court's construction, and said finding is therefore contemptuous of the court.

"Again, upon any construction of said patent, said finding is wholly unwarranted by the testimony, or by any part of it."

Upon this exception the circuit court held as follows:

"The exception to the first finding must be overruled'

"The construction of the patent which the finding as-'sumes, is the one given to it by Judge Leavitt, and it was 'concurred in by both the judges when the application for 'a preliminary injunction was heard. Whether the patent 'reaches further, and is also for each of the parts sever-'ally of the process which it describes, is a proposition, as 'before remarked, not necessary to be considered."

The specification of the patent clearly includes the entire process, and is not limited to the mere reheating of the car wheels.

1. The removal of the wheels from the mould as soon after being cast as they are sufficiently cool to be strong enough to be moved with safety, and before they have become so much cooled as to produce any considerable inherent strain, and their deposit in a pit, and their slow cooling therein, were parts of the described process indispensable for the effect desired.

2. The *entire* process is described.

3. The *entire* process is expressly claimed.

If the master had held otherwise, he would have disregarded the decision of the court which appointed him, and that decision was plainly demanded by the specification. It admits of no other construction than a claim of the entire process. *And that entire process, as described and claimed, was new in each one of its parts.*

There is no satisfactory evidence that the removal of the wheels from the mould to a suitably prepared pit, not previously heated, as soon as they were sufficiently hardened in the mould to allow them to be removed there, and their slow cooling in such a pit, without reheating them, had been practiced before the time when the patentee reduced his entire process, including the reheating, to successful practice.

The complainant's Exhibit C (p. 78) shows the application for the patent was received in the office August 2, 1847.

The trial wheels were made in February, 1847. (Whitney, 68; Burnham, 336, 337; Parry, 339.)

And his foreman (Snyder) says he began with Mr. Whitney, when he first started making wheels for the market, early in May, 1847.

Was he anticipated in any part of the entire process?

The only witnesses relied on are: 1st. Kidd. He did not begin till May, 1847, to pit any wheels. (See stipulation, p. 326.) He expressly says (p. 326) he knew nothing of the practice of Benedict, his predecessor at the foundry, who is not produced. And Kidd's name is not given in the answer as one having prior knowledge, &c. (7 Wall., 583.) Lobdell makes no pretension to any practice of pitting his wheels till December, 1847, or January, 1848, (p. 131, 11;) and Whitney had then made upwards of 3,000 for the market.

The entire process being new, each substantial part, as well as the whole, belonged to the patentee.

Moody *v.* Fisk, 2 Mason, 117.
Smith *v.* L. & N. W. Railway, 2 E. & B., 68.
Act of 1837, sec. 9.
Evans *v.* Eaton, 7 Wheat., 430.

The appellant also took exception to the 3d and 4th findings of the master, in these words, (p. 399:) "And the de-'fendant excepts to the findings III, IV."

These findings were as follows:

"That no process of annealing, in connection with pro-'longing cooling of cast-iron car wheels, other than that 'patented to the complainant April 5, 1848, and that de-'scribed in the patent of May, 1861, appears to be, or to 'have been, known in the manufacture of cast-iron car 'wheels.

"Taking annealing to mean reheating, in connection 'with slow cooling, I adopt this as a finding, and report it 'as such.

"That the said wheels made by the defendant required

'no treatment, other than that described in the said patent 'of complainant, to complete them as annealed wheels.

"This I adopt as a finding, and report it as such to the 'court."

These findings of the master are matters of fact, based on evidence exhibited to him, and no request was made to report the evidence on which his findings were made, or to separate it from the entire evidence exhibited before him.

And if the court should think it proper to search through the entire evidence in the record, it is believed *none* can be found in conflict with the conclusions of the master, and that all the evidence shows these findings to be correct.

The appellant further excepted as follows: "To all that 'part of the report commencing with the words 'com-'plainant's counsel asks the following findings,' and ends 'with the words 'precisely the wheels, then, that the de-'fendant manufactured, could not have been manufactured 'without using the process patented to the complainant, 'or its equivalent.'"

This is not a sufficient exception. It is too general, and points out no error. It simply shows dissatisfaction with all those findings of the master; whether erroneous in law, and, if so, why; or in fact, and, if so, upon what evidence is not stated.

These findings are mainly matters of fact, based on evidence before the master. There does not appear to have been any request to him to report that part of the evidence on which these findings were rested; nor, so far as appears, any call on him, by objection to these findings, to review them.

And when this exception is examined, it will be found to have no other foundation than the misconstruction of the patent; that only that part of the process which consisted in reheating the wheels was covered by the specification—a construction of the specification which has already been shown not to be in conformity either with

the specification itself, or the real scope of the actual invention.

The next exception is as follows:

"And the defendant, by way of stating more specifically 'his exceptions, refers to the first inquiry addressed to the 'master, as contained in the order of the court, to wit:

"'First. Whether the wheels made and sold by the de-'defendant had, or could have been made to have, any 'market value without being subjected to the process pat-'ented to the complainant?'

"And says that the master has refused to answer such 'inquiry categorically, as requested by defendant's counsel; 'and, instead of so answering, has inserted an argumenta-'tive finding, which conveys, by way of implication, that 'which is calculated to deceive and mislead the court."

The master did find as follows:

"But I find that wheels of the material, size, shape, and 'weight of those manufactured by the defendant could 'have been manufactured without the use of extraneous 'heat, at less cost, by either of the methods described in 'finding V of this report, and that wheels so manufactured 'would have had the same market value in the market 'where defendant sold said 19,819 car wheels, as if extra-'neous heat had been applied to them, as described in com-'plainant's patent, or as used by the defendant."

This was a categorical answer; and, at the same time, it proved to be a finding which was entitled to no practical effect, because it is not material what could have been done by using only a part of the patented process, when the defendant in fact used the whole. Reference is made to pages 262 and 271 for passages in the reports of the master, placing in a striking light the speculative findings requested by the respondent below.

The defendant further excepted as follows:

"And the defendant excepts to so much of said findings 'and report as may be construed to mean, that the 19,819 'car wheels made and sold by the defendant had any greater 'market value by reason of the application to them of ex-

Supreme Court of the United States.

No. 148.

ALBERT L. MOWRY, Appellant,

vs.

ASA WHITNEY.

APPEAL FROM THE CIRCUIT COURT OF THE UNITED STATES FOR THE SOUTHERN DISTRICT OF OHIO.

B. R. CURTIS,
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McGill & Witherow, Printers, 1107 E street, Washington, D.C.

Supreme Court of the United States.

ALBERT L. MOWRY, Appellant,
vs.
ASA WHITNEY.
} No. 148.

APPEAL FROM THE CIRCUIT COURT OF THE UNITED STATES FOR THE SOUTHERN DISTRICT OF OHIO.

POINTS FOR APPELLEE TOUCHING MR. COLLIER'S PRINTED ARGUMENT.

Preliminary Statement.

Before specifying the points relied upon by us in reference to such parts of Mr. Collier's printed argument as we think it necessary to reply to, we desire to state the object, design, and scope of Mr. Whitney's invention.

For more than thirty years the art of manufacturing cast iron railroad wheels has been a distinct and separate branch of the art of iron founding, and this distinction continues to the present day.

The characteristics which distinguish this from all other branches of the art of iron casting or founding, are:

That it demands a peculiar material—that is, iron possessing certain properties not common to all irons.

That the article produced must possess two different qualities in different parts, to wit: a crystalline, hard, and

necessarily brittle, but durable, periphery or exterior, and a granular, strong, and tough interior.

That the antagonism between these different parts and properties must be reconciled by some provision for adjusting their action and reaction upon each other in cooling.

In other words it is a distinct art—

1st. In the material employed.

2d. In the means employed, or the manner of treating, or mode of operating upon that material.

3d. In the effect of such mode of operation, or in the result attained and the article produced.

The object and design of the respondent's invention was to render possible the manufacture of a cast-iron railroad wheel, having a solid hub, and any desired form of plates, single or double, straight or curved, and possessing all the requisites of durability and strength in the respective parts, and yet free from the fatal defects attending all wheels, theretofore made, and not requiring the expenditure of special labor upon the mould or pattern before casting, nor upon the finishing of the wheel for use, after it had been cast and cooled. All of which he fully achieved, not by a new variation of form in the wheel, but by an entirely new and perfectly effective application of the mode of operation discovered by him, and which *eradicated* and *annihilated* all the difficulties so long contended with in vain, by previous inventors in this art. This new application of the mode of operation discovered by him was effected by means of a new process of prolonging the time of cooling, in connection with annealing wheels, which process, commencing with the chilled wheel "cast in the ordinary manner," comprised the following three steps or stages, to wit: first,

Arresting the cooling of the wheels at the earliest possible moment consistent with their safe removal from the mould, or, in the words of his specification, "as soon after being cast as they are sufficiently cool to be strong enough to move with safety, or before they have become so much cooled as to produce such inherent strain on any part as to impair its ultimate strength."

And inasmuch as some inherent strain might in practice be produced before the deposit of the wheel in the pit, which, if not counteracted, would impair the ultimate strength of the wheel, the second stage of his process was, immediately restoring to the wheel (by reheating it) that equilibrium of temperature in all its parts, with the disturbance of which equilibrium these inherent strains began to develop themselves, and the restoration of which equilibrium neutralized those strains and retrieved the strength lost by such premature and unequal contractions.

And, after having thus retrieved such strains as result from the very formation of the wheel, to prevent the recurrence of such disturbance and consequent strains, his third stage consisted in preserving an equilibrium of temperature in all its parts, by regulating and retarding the final cooling of the wheel, allowing the entire wheel to cool uniformly, and only so fast as the different parts would adjust themselves gradually and equably to each other, without the irregular contractions attending all the modes of treatment theretofore known, or employed in the art.

Points in reply.

I.

The printed argument contains the following passages on pages 1 and 2:

"In cast-iron car wheels—they being of unequal thickness of parts, the *hubs* and *flanges* being thick and heavy, and the *plates* comparatively thin—this natural tendency to unequal contraction and consequent inherent strain, if rapidly cooled, is enhanced by reason of the fact that the wheels are cast in moulds, the peripheries of which are of *iron*, which '*chills*,' as it is termed, and causes a sudden contraction of that part of the melted metal coming in contact with it; the *object* and effect of thus 'chilling' the peripheries, or 'tread,' of the wheels being to make them *hard* and steel-like, so that they will be capable of withstanding the wear of the rails upon them.

"To counteract this effect incident to the rapid cooling, processes of 'annealing,' as it is termed, have long been known and practised: in some instances the articles were removed while red hot to previously heated ovens, and there subjected to continued heat and suffered gradually to cool; in other instances, the articles have been annealed by *retarding* the cooling of the *thinner* parts by burning fuel on such parts or covering them with some non-conductor, and *accelerating* the cooling of the *thicker* parts by currents of air or otherwise; in other instances, the articles have been annealed simply by being removed red hot from their moulds and placed in pits, with or without sand, they being excluded from the air, and their own heat retained as long as practicable; the object, in common, of all such processes being to effect equality in contraction and prevent inherent strains."

We deny the correctness of this statement. There is no evidence in the case that any annealing process, or any slow-cooling process had been applied to counteract the effect of the chill in car wheels, or had been applied to car wheels at all prior to Whitney's invention. The only witness adduced by the appellants is Kidd, who did not begin to pit any wheels until some time after the 1st of May,

1847, (see stipulation, p. 326,) and Kidd's name is not given in the answer as one having prior knowledge. (7 Wallace 583.)

Kidd expressly says (p. 326) he knew nothing of the practice of Benedict, (his predecessor at the foundry,) who is not produced.

Whitney's trial wheels were made in February, 1847. (Whitney, 68; Burnham, 336, 337; Parry, 339.)

Snyder says he began as foreman with Mr. Whitney, when he first started making wheels for the market, early in May, 1847, (p. 85, ans. 2.)

The testimony of Knight, when rightly understood, has no tendency to show that any part of Mr. Whitney's process was old. By reference to page 39, answer 5, and to pages 42, 43, answers 27, 28, 29, and 30, it will appear, first, that the words "*heating* sand," at the close of answer 5, should be read "*heaping* sand;" second, that the process referred to by the witness consisted in covering the wheels while in the mould with an additional quantity of sand, or removing them into the open air, and there placing sand or loam upon them; third, that all this had been in substance known for centuries, and has nothing to do with Mr. Whitney's process, and, so far as applied to car wheels, must have been to "split hub" car wheels, which alone were known down to the time of Mr. Whitney's invention.

And this fully explains the meaning of that passage in Mr. Whitney's specification relied upon by the appellant as a disclaimer. That passage is as follows:

"I do not claim to be the inventor of annealing castings made of iron or other metal, when done in the ordinary way."

The "ordinary way," here referred to, is what is described by the witness Knight, which, as has already been said, includes no part of Whitney's process. (Asa Whitney, pp. 326, 327, 328.)

The master's final report contained the following findings, to wit:

"II. If, as is claimed by defendant's counsel, there is no infringement of the complainant's patent unless the wheels are subjected to the process of reheating—that is to say, if the process of slow-cooling used in connection with the reheating is old, and not a part of the complainant's invention, nor included in his patent—the master finds that no part of the profits realized by the defendant from the manufacture and sale of the said wheels was due to the use by him of the complainant's invention."

To this finding the following exceptions were taken by complainant:

"1st. Because there is no evidence to show that the process of slow-cooling was old, nor to justify the master in finding that it was old.

"2d. Because, in point of fact, not only the entire process described in the patent, but each part of such entire process, was the invention of the complainant; and the use of any material, substantial, and essential part of such entire process—the slow-cooling being a substantial, material, and essential part whereby only an improved chilled cast-iron railroad car wheel could be made, and beneficial effects, the same in kind if not in degree, attained, that were attained by the complainant's entire process—is an infringement of complainant's patent, and the profits derived from the use of such material, substantial, and essential part should be accounted for in this case.

"3d. Because it is not a legitimate subject of inquiry what would have been the possible profits from using some other than the patented process; but the true inquiry is, what were the actual profits from using the patented process which the defendant did use.

"4th. Because the evidence does not warrant the master in finding that the defendant would or could have made, by using the slow-cooling alone, the same profit which he did actually realize from using the entire process, which the defendant did in fact use."

By reference to the final decree, article first, it will be seen that the first and fourth of these exceptions were overruled, and the second and third sustained, (p. 404.)

The first exception was rightly overruled, because there was evidence showing that some castings (though not car wheels) had for some purpose been slow-cooled.

The second exception was rightly sustained, because it correctly states the result of all the evidence in the case.

The third exception was rightly sustained, because the subject of inquiry therein mentioned, would have been speculative merely, and did not belong to the case, as will be fully hereafter shown in another connection.

The fourth exception was rightly overruled, because the master made no such finding, as therein alleged, and refused to make such finding when requested by the appellant. By reference to page 262, the following passage in the master's report will be found:

"The master further reports that he has been requested, by counsel for defendant, since the filing of the original report herein, to find as follows:

" 'If the court should determine, as matter of law that the defendant is liable to account for the entire profit made by him in his manufacture and sale of annealed car wheels, (19,819,) then I find that he has made profit to the amount of $91,501 86.

" 'I do find, however, that the defendant's business was not increased by the annealing process employed in the manufacture of wheels; that he would have sold as many wheels if he had not employed the complainant's process; that the complainant's process increased the cost of the wheels, while no increase over unannealed wheels was made in the price; that consequently the defendant made no profit simply by reason of annealing or employing the complainant's process for cast-iron wheels made by him, and would have made a larger profit than $91,501 86 if he had not annealed his wheels.'

"This finding the master declines to make. He is not able to find in the testimony any warrant for finding what would have been, had the defendant not done what he did do. Besides, the testimony does not show what was the extent of the business of the defendant before he commenced using the process enjoined in this cause; and if it did, the tables submitted with the report of the master show that the defendant's business very largely increased from 1861 to 1865; that is, during the war of the rebellion. The books of the defendant, which were submitted to the master, show that among the heaviest orders for wheels were those from or on account of the Government of the

United States. The defendant himself testifies that, during the war, a larger number of wheels were required, and we know, as matter of public history, that the demands of the Government for transportation for troops, supplies, &c., enlarged the business of railroads and of manufactures of car wheels and other materials for railroads beyond precedent. The testimony, too, shows that, since 1865, the business of the defendant has diminished.

"Now, the master cannot undertake to determine whether the use of the process complained of in this cause did or did not bring an increase of business to the defendant. He has, in his opinion, nothing to do with hypotheses. It is his business to deal with facts only."

By reference to page 271, it will appear that the master was requested by the appellant to make the following finding:

"Second. That, in so far as there is testimony upon the subject, such testimony tends to prove that the application by the defendant, to wheels manufactured by him, of the complainant's improvement, did not make the commercial value of such wheels greater than the commercial value the same wheels would have had if that improvement had not been applied to them, and they had been treated in the manner the defendant treated them before the application of the complainant's improvement; that is, by placing them in pits and prolonging the time of their cooling without reheating or 'annealing' them: and, further, such testimony tends to prove that the defendant sold no greater number of wheels by reason of the use of complainant's improvement than he would have sold had he continued the manufacture of wheels in the same manner as before the employment of that improvement."

Upon which the master reports as follows:

"The master declines to make this finding. The first part of it has been substantially found, and is contained in the master's supplemental report, and the last part is only another form of a finding then requested and refused. How many wheels the defendant would have sold, had he continued the manufacture in the same manner as before the employment by him of the complainant's process, is, in the opinion of the master, matter of speculation, not of fact, and to be rejected for the same reason that speculative profits are not allowed. The master regards the state-

ment of the witnesses Bromley and McLaren, as to what purchases they would have made had the defendant manufactured unannealed wheels as speculations rather than testimony. Besides, the fact that the defendant, from 1861 to 1867, and until he was stopped by injunction, manufactured, except in one or two instances, car wheels exclusively by the complainant's process, at an extra cost of twenty-five cents per wheel, without corresponding advance in the selling price, and that he published a circular asserting the superior quality of wheels so manufactured, and that many railroad companies then using them would certify to that superior quality, seemed to the master to be entitled to some consideration; while the fact that the company which the witness Bromley represented, (not, however, as purchasing agent, but merely to make requisitions for purchases,) after the defendant was enjoined and returned to the manufacture of what are styled unannealed wheels, transferred its orders to Nash, who manufactured annealed wheels, was put by the master against Bromley's assertion that they preferred the unannealed wheels; and the fact that a strong certificate in favor of the annealing process, signed by the witness McLaren, as superintendant of the Cincinnati, Hamilton, and Dayton Railroad Company, was attached to the published circular above referred to, qualified somewhat, in the master's opinion, the testimony of that witness that he opposed the annealing process. The master is not, therefore, able to see or to report that the annealing process, as used by the defendant, and which the court has decided was an infringement of the plaintiff's process, had no influence upon the defendant's business. He is of opinion that the findings contained in the supplemental report are as strong as the testimony warrants. These remarks are intended to apply also to the first finding requested by complainant's counsel, and hereinbefore refused.

"The master has thus given his reasons for his findings and refusals as briefly as possible, and in response to the request of counsel."

These refusals of the master to find, as requested, are amply justified by evidence derived from the appellant himself. (See his circular, pp. 223, 224.)

It is impossible to peruse this circular and the certificates published therein, and resist the conclusion that reheating was important in his business, and that if the master or the court were called upon to speculate about what might have been, instead of finding what actually was, such speculations would have been effectually controlled by these public declarations, made by the appellant, the truth of which he cannot now deny without thereby accusing himself of intentional bad faith.

The master also found, pp. 396–397:

"I find that said annealed wheels—using the term annealed in the sense above indicated—could not have been made by any process outside of the complainant's patent.

"The application of extraneous heat in the manner described in the complainant's patent, and as used by the defendant in the manufacture of said wheels, retrieves the metal in some degree from the strain which begins the moment the wheels are cast, and in so far as that is accomplished the wheels are strengthened, and their liability to break overcome. This retrieving is accomplished only by the application of extraneous heat, and extraneous heat cannot be applied without infringing the complainant's patent.

"Precisely the wheels, then, that the defendant manufactured could not have been manufactured without using the process patented to the complainant, or its equivalent."

II.

Referring to page 11 of Mr. Collier's printed argument, a reference will be found to a suggestion made at the original hearing of the cause by Mr. Fisher, one of the counsel for the complainant, that the respondent might resort to Lobdell's process, which was substantially different from that of Mr. Whitney. Such a suggestion was undoubtedly made, that Lobdell's process was, in point of fact, substantially different from Mr. Whitney's process. Whether Lobdell in fact practised any part of Mr. Whitney's process, beginning, as Lobdell himself admits, in December, 1847, or January, 1848, subsequent to Mr. Whitney's in-

vention, had not then been a matter of any importance in the cause, because Mowry practised the whole of Whitney's process, and the attention of counsel had not at that time been drawn, in any way, to the question whether what Lobdell practised infringed Whitney's patent.

The first time any such inquiry became of any practical importance in the case was before the master, in taking an account of profits. A casual remark of counsel, under these circumstances, cannot be received by this court as entitled to any weight in the investigation, upon the actual proofs in the record, of the question whether Whitney invented the entire process he has claimed.

III.

The other matters stated and referred to in the printed argument relate, somewhat loosely, to the subjects before the master and his action thereon, and to so much of the final decree as was based on his action. As to all this, we respectfully insist that the reports of the master and so much of the final decree as was based thereon can be examined only under and with constant reference to the exceptions regularly taken, and which the circuit court was required to pass upon, in order to arrive at a final decree. Each of these exceptions is examined in our brief filed in this cause. (Hudgins *v.* Kemp, 20 How., 45.)

IV.

On page 12 of the printed argument, the point is taken that Whitney's patent is void for want of novelty. It is not proposed, in this connection, to repeat the argument found in our brief and developed in the oral argument of Mr. Stoughton; but, under the authority of the case of Seymour *v.* Osborne, 11 Wall., 516, we call upon the appellant to produce from this record evidence of any prior specification of a patent, any printed publication, or any practice which taught the public how to make chilled car wheels according to Whitney's process as fully as Whit-

ney's specification teaches it: for, in the words of Mr. Justice Clifford, speaking for this court, in that case.

"Patented inventions cannot be superseded by the mere introduction of a foreign publication of the kind, though of prior date, unless the description and drawings contain and exhibit a substantial representation of the patented improvement, in such full, clear, and exact terms as to enable any person skilled in the art or science to which it appertains to make, construct, and practice the invention to the same practical extent as they would be enabled to do if the information was derived from a prior patent. Mere vague and general representations will not support such a defense, as the knowledge supposed to be derived from the publication must be sufficient to enable those skilled in the art or science to understand the nature and operation of the invention, and to carry it into practical use. Whatever may be the particular circumstances under which the publication takes place, the account published, to be of any effect to support such a defense, must be an account of a complete and operative invention capable of being put into practical operation." (Webs. Pat. Cases, 719; Curt. on Pat., 3d ed., sec. 378*a*; Hill *v.* Evans, 6 Law Times, N. S., 90; Betts *v.* Menzies, 4 Best & S., Q. B., 999.)

V.

All that part of the printed argument, between pages 12 and 35, which it is material to notice is put forward as if it related to the utility of the invention, a subject introduced into the cause by an amendment of the answer found on page 36. It seems to us that the appellant has confounded the issue of the utility of the invention with the question of the sufficiency of the specification, two subjects totally independent of each other, and the latter not raised by the answer. An invention, as conceived of and practiced by the inventor, and, through that practice, taught to the public, may be a highly useful invention, and a proper subject for letters patent; and if the inventor, through some inadvertence, has failed to teach the public how to use it by his specification, he may surrender his

patent, and correct his inadvertent mistake. The only point taken by this answer is, not that the patentee inadvertently or otherwise failed to teach how to practice his invention, but that the invention itself was not the subject of letters patent.

But passing from, without waiving, this point, we respectfully submit that the specification does state sufficiently, according to the nature of its subject, how to practice this invention, so as to produce results valuable in practice. The presumption at the outset is, that the specification is sufficient. The burden of proof is upon the appellant to show its insufficiency. There must be a clear preponderance of the evidence, that, looking to all parts of the specification, considering the object to be attained, and all the described means of attaining it, there is still something wanting which, having reference to the nature of the subject, should have been more precisely specified, and which was not necessarily left to the judgment of skillful persons in practising the art.

It is not insisted that the result to be produced, namely, a sound chilled cast-iron car wheel, is not sufficiently pointed out; nor is it contended that any part of the process by means of which this result is to be produced is defectively described, until you arrive at the question to what degree of heat the wheel should be raised before its cooling begins.

Nor is it contended that there is any ambiguity or want of attainable certainty in the direction "that the temperature of all parts of the wheels deposited therein is to be raised to the same point;" nor in the direction that *when and so soon as* it is so raised, they are to be allowed to cool; nor in the direction that the furnace must be so constructed, and under such control, that when and as soon as all parts of the wheel have been raised to the same point, the cooling is at once to begin. The objection is founded solely on what the specification says, in addition to all this, namely, "say a little below the point at which fusion commences;" and it is supposed that this last suggestion, which,

from the nature of the subject to which it relates, and the form of words employed, could not be intended to be otherwise than vague and general, is to be considered as not only controlling, but nullifying not only the declared object to be attained, but the more specific direction given, how to attain it.

In the first place, from the nature of the subject, nothing precise and fixed could have been intended. In the next place, the words "say a little below" fairly indicate vagueness; and, taken in connection with the specific directions that immediately precede these words, "that the temperature of all parts of the wheels is to be raised to the same point," it is manifest that nothing more was intended than to indicate a maximum as well as the subject-matter permitted, beyond which the operator was in no case to go. The thing to be attained in this part of the process was, to raise the temperature of all parts of the wheel to the same point; manifestly this could be no fixed quantity capable of being described. The hottest part of one wheel would necessarily differ from the hottest part of another, by reason of the different times at which they were poured, and the different distances through which they must be transported to the pits from the different parts of the foundry; and the same would be true of different sets of wheels.

From the very nature of the subject-matter, then, nothing could be required in this specification beyond a direction to the operator to bring all parts of each wheel into the same temperature, and to indicate necessarily vaguely the maximum beyond which he must not pass; having reference to the known object of producing a sound chilled car wheel, and necessarily leaving to the judgment and skill of the operator precisely what was to be done under the varying circumstances of each case.

VI.

Passing from the construction and evident meaning of the specification, we further say:

1. Whitney had great knowledge of this art and its cognate branches, shown not only by this invention, but by his previous history, detailed on pages 326, 327, 328.

2. It is not charged in the answer that he either inserted in or omitted from the specification anything with a view to deceive the public.

3. It follows that the inventor, being a person of great experience and skill, and with every motive and desire to give suitable and sufficient directions in his specification, has so entirely failed to do so, that his patent was and always has been, for twenty-one years, utterly void. This the court will not easily believe, and there is nothing in this record demanding that belief.

Two witnesses, Kaye and Wade, are mainly relied upon. The hearing of this case was begun on the 25th of January, 1867. On the 11th of the same January notice was served on the complainant's solicitor, that the defendant would take depositions of sundry witnesses, not naming them, at Pittsburg, on the 17th of the same January. The complainant's solicitor indorsed on the notice, that he waived no objections to the taking of the evidence, and did not appear to cross-examine. (See p. 156.) He was not bound to appear, and the testimony was irregularly taken. No application to open the rule for taking the evidence in the case, or to extend the time for taking it, had been made to the court; and the cause had been set down for hearing on the 25th of January. Under these circumstances, if these depositions are to be used at all, they must be regarded simply as *ex parte* depositions.

Kaye says, that he manufactured 100 wheels strictly in accordance with Whitney's patent. What he means by "strictly in accordance with Whitney's patent," he has not told us; and there being no cross-examination, we could not ascertain to what degree he reheated these

wheels, how long he continued that degree of heat we do not know.

It would seem from his statement (on p. 167) "the Whitney process is nearly allied in principle to that used in cooling heavy ordnance by us some years ago. We then attempted to secure all the heat in the gun pit, and retain the same for the longest possible time, it having no other way of escape than through the earth." Now if, following out this fancied analogy, he attempted to get all the heat he could in the wheel pit, and retain the same for the longest possible time, he was certainly not following the directions of the specification, which plainly says that the heat required is that which is sufficient to raise all parts of the wheels to the same temperature, and, when so raised, the further access of heat is to be immediately stopped, and the cooling process to begin; and it is to be observed, that this process for cooling heavy ordnance, which this witness had previously practised, and says is analogous to Whitney's, had in view neither the same result to be atttained, nor the same means of attaining it. If the court will refer to pages 158 and 159, of Wade's testimony, it will be seen that this process of cooling heavy ordnance *was practiced for the purpose of softening;* while a person of ordinary intelligence must know that Whitney's process was designed to preserve the chill unimpaired, and not to soften it.

Kaye does not appear to have been a car-wheel maker, nor to have had previous experience in this most difficult branch of the art of casting chilled car wheels. Nor does Kaye state that he was acquainted with the fact, which is clearly proved in this case, that it was necessary to select and employ iron having the peculiar property of taking and preserving a perfect chill. (See Dougherty, p. 59, ans. 7; Lewis, p. 62, ans. 4; Geo. Whitney, p. 67, ans. 8; Asa Whitney, p. 82.) *

What degree of heat, and how long it must be continued in order to destroy the chill, the appellant himself has un-

* Similar remarks as to the character of his deposition, being ex-parte, apply to Wade, whose testimony is less important.

dertaken to show by the testimony of his expert witness, Wayne, (p. 172, ans. 26,) who says:

"The chill upon this specimen of iron [being respondent's exhibit, No. 9] was from ½ to ⅝-inch in depth. This piece of iron I placed in the crucible, and submitted it to a bright red heat in a furnace for about 10 hours. It was allowed to remain in the same furnace, and allowed to gradually grow cool, which occupied about the same time."

We have failed to find in Whitney's specification directions to treat his wheels in that manner.

We wish also to draw the particular attention of the court to the testimony of the appellant's witness, Bosworth, on p. 128, ans. 8:

"Ques. 8. State whether you have ever made any experiments to test this matter; and if you shall answer yea, then state what those experiments were.

"Ans. My experiment was all an accidental experiment. It was a piece of car wheel going through the cupola without melting, except a little of one end; it was dropped to the bottom of the cupola, and laid there in the hot coals all night. That drew the temper out of the wheel. By the temper I mean the chill of the wheel, so that the chill part of the wheel, that which had formerly been chilled, was filed—could take a file and cut right into it. You can't file into the chill part of a wheel, no more than you can into steel; you may mark it, and that is all you can do."

It thus appears that the heat was sufficient to melt all the rest of the charge, and yet only sufficient to reduce the chilled fragment to the condition of an unchilled casting.

If any evidence is necessary that, from the nature of the case, much must be left to the judgment and skill of the operator, it is to be found in the depositions of Asa Whitney, pp. 329, 330; cross-answers 12 to 25; Snyder, p. 85, ans. 2, 3, 4, 5; p. 87, ans. 4 to 7; Redfield, p. 85, ans. 6.

And it is manifest that the same judgment and skill of the operator are called for under Mowry's patent, both as respects the quantity of charcoal to be used, and the supply of oxygen for its combustion; indeed his specification so states. (See folio 69, p. 34.)

VII.

In reference to the remarks found on page 36 of Mr. Collier's argument, that most of our witnesses had not seen Mowry's process, and testified from an examination of his specification, it may be of some importance to refer the court to that paragraph in the answer of Mowry, on page 27, "that he has manufactured and annealed car wheels according to the process described in said letters patent, and not otherwise."

VIII.

In reference to all that part of Mr. Collier's argument which relates to the master's report and the subject of profits, we have again respectfully to submit that all parts of the several reports of the master not duly excepted to by the appellant, according to the rules of practice of the court, stand confirmed, no question arising thereon which was not raised in the court below by a regular exception, and thus brought to the consideration of the circuit court, and adjudicated by that court, is open on this appeal.

This observation is sufficient to dispose of a large part of this branch of the argument, which pays no attention to the limitations fixed by the exceptions, but proceeds to deal with the whole subject as if no exceptions at all were necessary.

In the brief filed by us in the cause, we have taken up each exception in its order, and submitted such suggestions as we deemed pertinent in reference thereto.

But there are two or three subjects, which, perhaps, may usefully be adverted to in this connection.

1. It is insisted that Mowry was licensed under Murphy's patent, Washburne's patent, and Atwood's patent, (the first of which was for a process; the last two were for modifications of form which have no connection with our patent,) and that the master has made him no allowance for the cost of those licenses. To this we answer, in the first place, that he never claimed any allowance from the

master on this account, took no exception to any one of the master's reports, for the master's failure to make him any such allowance, and the circuit court was not called upon by the appellant to adjudicate on any such claim. And we say further, that it did not appear that he worked under the Murphy or the Washburne patent.

The Murphy patent was for a process by which a blast of cold air was blown through the hub of a single wheel as a substitute for the older method of pouring water through. This method was not used by Mowry, as appears by his own specification, which directs that the damper should be "opened so as to admit just sufficient air to effect the combustion of the contained charcoal in the space of seventy-two hours less or more as may be found necessary for the annealing operation."

It is plain that such an almost imperceptible current of air passing through the hubs of twelve red-hot wheels, with layers of charcoal interposed, would not amount to Murphy's process; and Mowry's witness (First, p. 228, ans. 51) says Mowry was not using Murphy's process, nor had he used it at any time since he was enjoined, to his knowledge.

2. On pages 62 to 64 of Mr. Collier's argument is found an objection to the report of the master respecting the quantity of iron used by Mowry in the manufacture of the wheels in question. On page 266, folio 510, of the record, will be found, in substance, the same objection, made by Mr. Collier to the first draft report of the master. On page 270, folio 519, it appears that the master had taken this objection into consideration and there reports thereon, and shows that the objection was without foundation. To this part of the master's report, thus overruling this objection to his draft report, no exception was filed, and the circuit court was not called upon in any way to adjudicate upon this objection. It is respectfully submitted, first, that the objection is no longer open to be taken, and, secondly, that the master's report satisfactorily shows that it never had any foundation.

3. But, in addition to this alleged error of the master,

concerning the quantity of iron used in the manufacture of the wheels in question, Mr. Collier, (on p. 63,) specifies a particular error, which was never before brought to the attention of the master, or anybody else, for a reason which will presently appear.

That particular error is said to have been that amongst the iron used in the manufacture were quantities of old wheels, the weights and cost per pound of which are tabulated from Mowry's books by his witness, (First, Rec., pp. 239, 240;) and it is to this table and its results that Mr. Collier refers, on page 64 of his argument, where he says, that the cost of these old wheels was $80,313 45: whereas the master allowed only $34,808 45, "being $45,505 less than was paid for them, by testimony of the highest character, and not disproved or attempted to be in any manner whatever."

It must be observed that Mr. Collier's objection is not founded on the fact that the master did not make a sufficient allowance for old wheels purchased by Mowry, and not appearing in the tabulated statement, nor could he make such an objection, because the master allowed precisely what was claimed by Mowry's bookkeeper to be sufficient to cover this item, as will appear by reference to page 241, answer 6. His objection is founded on the fact that the tabulated statement of First, found on pages 239, 240, shows the aggregate cost of that iron to have been $80,313 45; whereas on this account the master has allowed $30,313 45, an objection which would be unanswerable, if there had not been a misprint in the statement of this aggregate sum at the foot of page 240 of just $50,000 by the accidental substitution of an eight for a three, thus producing a discrepancy of just that amount between the total of this table on page 240, and the recapitulation of the tables found on page 249, where this error is not repeated.

IX.

In conclusion, we submit that the interest allowed by the decree was warranted by the law and the facts of the case.

In his original draft-report, the master computed interest on the profits he found down to the first day of August, 1868, at 6 per cent., (page 260, folio 499.)

Finding that a mistake had been made in the arithmetical computations, which amounted to $10,000, the master prepared a corrected report, in which he computed the interest on the corrected sum of profits, bringing the interest down to the same date of August 1, 1868. To this corrected report the appellant submitted to the master various objections, which appear on pages 265 to 268 inclusive, and amongst them (page 265, folio 512) took an objection to the allowance of interest by the master.

The master made a supplemental report upon these objections, but did not qualify that part of his previous report which allowed interest.

No exception founded on the allowance of interest was at any time filed in the circuit court, and when the case came on for argument before Mr. Justice Swayne to obtain directions for a final decree, no question was made that interest upon profits was properly allowable; so that, from the time when the appellant called on the master to correct his report on the subject of interest, and the master declined to do so, down to the time of this hearing, there has been complete silence and acquiescence in its allowance.

We further respectfully submit that, if the appellant was now in a condition to object to this allowance, this court would say it was rightly allowable.

In the case of Silsby *v.* Foote, relied upon by the appellant, interest and costs were disallowed, apparently, because there had been no disclaimer filed—which was necessary to establish the validity of the patent.

In Leroy *v.* Tatham, interest was also disallowed, but no explanation is made in the opinion of the Court upon that subject. By reference to the record in that case, it

will be found that the master did not ascertain that the defendant had actually realized the amount of profit which he had quoted, or that there were any data of times and sums upon which a precise computation of interest could be made, it being found in the master's report only that the defendants had made a specific number of pounds of lead pipe—the usual profit of the trade thereon being so much per pound; the interest being averaged upon such estimated profit.

But in the case at bar the precise amount of profit actually realized by the defendant from month to month, and by him mingled with his own funds, is found by the master, and a precise computation of interest at 6 per cent. is made thereon.

In addition to this, the complainant continued the manufacture from April 26, 1866, when, as is stated on the 9th page of Mr. Justice Swayne's opinion, "he was advised by the court that in their opinion of the case, as presented, he was violating the complainant's patent, but was permitted to go on under a bond to account for his profits," until April 5, 1867, when he was finally enjoined.

We understand it to be a long-established rule in the second circuit to allow interest on profits in a case like this.

See Tatham *v.* Lowber, 4 Blatch, 86; Troy Iron & Nail Co. *v.* Corning, 3 Fisher, 497.

We submit that, inasmuch as this infringer is looked upon and treated by a court of equity as having received all his profits as the trustee of the patentee, and has retained them and used them in his own business, he ought, in conformity with the settled rules of equity law, to account for interest thereon; and, when it is remembered that Congress has authorized a court administering the common law to treble the actual damages sustained by a patentee; and that the recent act of 1870, § 55, has empowered a court of equity to award the complainant, in addition to the profits to be accounted for by the defendant, the damages the complainant has sustained, and to

assess the same, or cause the same to be assessed under its direction, giving the court the same powers to increase the same in its discretion that are given by the old acts to increase the damages found by verdicts in actions on the case, it cannot be considered inequitable, or otherwise than in accordance with the spirit of the patent laws, to allow six per cent. interest in a case like this, upon the actual profits realized by the infringer. In no other way can the motive to infringe be properly controlled.

B. R. CURTIS,
E. W. STOUGHTON,
HENRY BALDWIN, Jr.,
Of Counsel.

Circuit Court of the United States

FOR THE SOUTHERN DISTRICT OF OHIO.

ASA WHITNEY vs. ALBERT L. MOWRY.

SWAYNE, JUSTICE.—This case was finally heard upon the merits by my brother Leavitt, the district judge, holding the circuit court. He decreed that a perpetual injunction should be awarded, and that an account should be taken of the profits made by the defendant in violation of the rights secured to the complainant by his patent. The case was referred to a master to take the account. The master performed this duty, and reported the results.

Both parties excepted, and the case is now before me upon these exceptions. They have been fully and ably discussed by the counsel upon both sides.

At the hearing, a preliminary motion was submitted by the defendant for leave to amend his answer by setting up that the extension of the patent was obtained by the complainant by means of fraud and perjury. This motion also was very fully argued.

Upon that subject, it is sufficient to remark that the extension cannot be questioned in this proceeding. Such an inquiry can be gone into only in a proceeding had directly for that purpose. The action of the commissioner was judicial in its character, and cannot be collaterally brought under review as matter of defence in a suit against an alleged infringer.

The question was fully considered in the case of the Providence Rubber Company vs. Goodyear's Executor and others, decided by the Supreme Court at the last term. Such was the unanimous judgment of that tribunal.

The complainant filed two exceptions to the supplemental report of the master, dated September 17th, 1868. They are are as follows:

"*First exception.*—The evidence does not warrant the "master in finding, as matter of fact, 'that the defendant "did not, when he began the use of said process, nor af- "terwards, while he continued its use, make any differ- "ence in the quality of iron used for the manufacture of "car-wheels, nor in the weight or form of car-wheels, nor "by reason of the use of such process, in their price.'

"*Second exception.*—The evidence does not warrant "the master in finding, as matter of fact, 'that the de- "fendant was unable to discover that his business was "increased by the use of said process; that it was with "a great deal of difficulty that he introduced the an- "nealed wheels; that the railroad companies purchasing "from defendant preferred the old wheels, that is to say, "those manufactured by the process used by the defend- "ant prior to April, 1861, for one or two years after the "new annealed wheels, that is to say, the wheels annealed "by the process complained of in this cause, were first in- "troduced; and that since the defendant has been en- "joined in this cause, and has abandoned the use of the "process complained of, he has had the same customers— "excepting the little Miami and the Columbus and Xenia "railroad companies, and it does not appear that said com- "panies have withdrawn their custom on account of said "abandonment—and has sold the wheels he has since "manufactured without the process complained of as read- "ily as those manufactured by the use of said process, and "at the same prices.'"

The ground of these exceptions is, that the facts found are not warranted by the evidence before the master. In my judgment they are sustained by that evidence, and the exceptions are, therefore, overruled.

The complainant also excepted to certain parts of the supplemental report of the master of March 23, 1869. The parts of the report to which these exceptions refer are as follows:

"II.—If, as is claimed by the defendant's counsel, there "is no infringement of the complainant's patent unless the "wheels are subjected to the process of reheating, that "is to say, if the process of slow cooling used in connec- "tion with the reheating is old, and not a part of the "complainant's invention, nor included in his patent, the "master finds that no part of the profits realized by the "defendant from the manufacture and sale of said wheels "was due to the use by him of the complainant's inven- "tion."

"V.—The master finds that the wheels aforesaid could "have been removed from the moulds and finished with- "out being subjected to the reheating process—1st, by "placing them in pits as soon as they could be handled, "covering them with hot sand, and thereby slow cool- "ing them; 2d, by placing them in like manner in pits, "without any fuel, covering the pits, and thereby slow "cooling them.

"The master finds that wheels so manufactured have, "and did have from April 1st, 1861, to April 7, 1867, a "market value equal to that of wheels manufactured by "the use of the process complained of in this cause.

"But I find that wheels of the material, size, shape, "and weight of those manufactured by the defendant "could have been manufactured without the use of ex- "traneous heat, and at less cost by either of the methods "described in finding V. of this report, and that wheels

"so manufactured would have had the same market value,
"in the market where the defendant sold said 19,819 car-
"wheels as if extraneous heat had been applied to them,
"as described in the complainant's patent, or as used by
"the defendant."

The first part of the report covered by these exceptions is not very clearly expressed.

It was not denied or questioned by the defendants counsel until very recently—so far as I am advised—that the patent does cover the entire process which it describes, of slow cooling in connection with reheating. At the hearing upon the merits it was expressly admitted by one of the counsel for the complainant, that reheating alone, *in connection* with subsequent slow cooling, was the invention or discovery of the patentee and what the patent was for. It was conceded that slow cooling was in prior use and previously well known. It was also conceded that slow cooling without reheating would not be an infringement of the patent. The language of the counsel referred to was, "If he (Mowry) does not think, as his counsel have argued, that there is anything in Whitney's idea of reheating, let him adopt Lobdell's dry sand process, or some other that is obviously different from ours, so that," &c. This construction was not dissented from by the other counsel upon the same side who participated in the argument.

It has since been, and is now, claimed by the complainant that the patent covers not only the reheating and slow cooling in combination, making the entire process described, but also the several parts of the process taken separately, including slow cooling without reheating, as where slow cooling alone is used by the alleged infringer. On the other hand, I understand it was claimed before the master by the defendant, that the patent is to be so construed as to limit its effect to reheating, and that if the defendant used slow cooling in connection with reheating,

as described in the specification, he is to be held liable only so far as his profits are shown to have been increased by the element of reheating; hence the finding of the master under consideration. To this view of the subject I cannot accede.

Whatever else the patent may be for, it is clearly for the process described as *an entirety*. All the wheels to which the master's account relates were finished by both reheating and slow cooling. This brings the case clearly within the patent.

I do not deem it proper to consider open any question which was foreclosed by my learned brother in settling the decree by which the case was referred to the master. Whether slow cooling without reheating is covered by the patent, and whether the patentee was the original and first inventor of that process as applied to car-wheels, are inquiries wholly outside of the case and not necessary to be considered in its proper determination. This hypothetical finding of the master ought not, therefore, to be in the record. For these reasons the exception is sustained.

The other exceptions relate to the master's conclusions from the testimony touching the several propositions of fact which the exceptions involve.

I think the testimony sustains the findings, and therefore overrule the exceptions.

The defendant excepts to the following portions of the master's report of March 23, 1869.

"I.—If, as is claimed by complainant's counsel, the "entire process of reheating and prolonged cooling, used "by the defendant in the manufacture of said wheels, "was an infringement upon the complainant's patent, the "master finds that the total profits realized by the de-"fendant from the manufacture and sale of said wheels, "was due to the use by him of the complainant's inven-"tion.

"III.—The master finds that, had said wheels, manufac-
" tured by the defendant, been left to cool in the open air,
" they would have had no market value as car-wheels; they
" would have been worth only the value of the iron of
" which they were made. Reheating in connection with
" slow cooling, or slow cooling without reheating, is in-
" dispensable to make marketable cast-iron car-wheels
" of the configuration of those made by the defendant.

"IV.—The master finds that there is no reheating
" process for the manufacture of cast-iron car-wheels
" outside of the complainant's patent.

" *Complainant's counsel ask for the following findings:*

" 1st. That the wheels of which the master has taken
" an account, made and sold by the defendant, were an-
" nealed wheels, and were sold as annealed wheels.

"This I adopt as a finding, and hereby report it as
" such to the court.

" 2d.—That the process patented to the complainant,
" and, as found by the court, used by the defendant in
" the manufacture of said wheels, conferred upon them
" their entire market value, and their entire value above
" their weight in iron.

" If the court shall decide that the complainant's pat-
" ent includes prolonging the time of cooling the wheels,
" as used by the defendant, I adopt this as a finding;
" but if the complainant's patent covers only the appli-
" cation of extraneous heat to the wheels after they are
" taken from the moulds, I decline to make this finding.

" 3d.—That no process of annealing in connection with
" prolonged cooling of cast-iron car-wheels, other than
" that patented to the complainant April 5th, 1848, and
" that described in the patent of May, 1861, appears to
" be or to have been known in the manufacture of cast-
" iron car-wheels.

"Taking annealing to mean reheating in connection

" with slow cooling, I adopt this as a finding, and report " it as such.

" 4th.—That the said wheels made by the defendant " required no treatment, other than that described in the " said patent of complainant, to complete them as an- " nealed wheels.

" This I adopt as a finding, and report it as such to the " court.

" 5th—That the said annealed wheels made and sold " by the defendant could not have been made by any " process outside of the complainant's patent.

" This will be considered in connection with the re- " quests by counsel for defendant, as follows:

" I am requested by counsel for defendant to embody " in my report the specific inquiries addressed to me by " the court, and to answer them in the affirmative or neg- " ative, as the fact may appear.

" *First.*—Whether the wheels made and sold by the " defendant had, or could have been made to have, any " market value without being subjected to the process " patented to the complainant.

" *Second.*—If they had, or could have been made to " have, such value by any annealing or slow cooling " process outside of the complainant's patent, how much " additional and greater market value, if any, they de- " rived from being subjected to said patent process.

" I find that said annealed wheels (using the term an- " nealed in the sense above indicated) could not have " been made by any process outside of the complainant's " patent.

" The application of extraneous heat in the manner " described in the complainant's patent, and as used by the " defendant in the manufacture of said wheels, retrieves " the metal, in some degree, from the strain which begins " the moment the wheels are cast, and, in so far as that is " accomplished, the wheels are strengthened, and their lia- " bility to break overcome. This retrieving is accomplished

" only by the application of extraneous heat, and extra-
" neous heat cannot be applied without infringing com-
" plainant's patent. Precisely the wheels, then, that the
" defendant manufactured could not have been manu-
" factured without using the process patented to the
" complainant, or its equivalent.

" And the defendant excepts to so much of said find-
" ings and report, as may be construed to mean that the
" 19,819 car-wheels made and sold by the defendant,
" had any greater market value by reason of the appli-
" cation to them of extraneous heat in the annealing
" pits, than they would have had if they had been left
" to cool there by a retention of their own heat, for the
" reason that the entire testimony taken pursuant to the
" order of the court, including the testimony of the com-
" plainant, shows that no additional market value is
" given to car-wheels by the application to them of ex-
" traneous heat in the process of cooling them."

The exception to the first finding must be overruled.

The construction of the patent which the finding assumes is the one given to it by Judge Leavitt, and it was concurred in by both the judges when the application for a preliminary injunction was heard. Whether the patent reaches further, and is also for each of the parts severally of the process which it describes, is a proposition, as before remarked, not necessary to be considered.

The exceptions to the 3d and 4th findings are also not well taken. Those findings, in my judgment, are fully sustained by the evidence.

The responses of the master, made at the request of the counsel of the parties, are, I think, correct. The exception to this part of the report is overruled.

The last exception is without foundation. The fact of which it is predicated does not exist. There is nothing in the report which can be construed to mean what is suggested. On the contrary, the master says:

"But I find that wheels of the material, size, shape, " and weight of those manufactured by the defendant, " could have been manufactured without the use of extra- " neous heat, at less cost by either of the methods de- " scribed in finding V. of this report, and that wheels so " manufactured would have had the same market value in " the market where defendant sold said 19,819 car-wheels, " as if extraneous heat had been applied to them, as de- " scribed in complainant's patent, or as used by the de- " fendant."

It was strenuously insisted by the counsel for the defendant, at the hearing upon the exceptions, that reheating "to a point a little below that at which fusion commences," called for by the specification, would destroy the chill and ruin the wheels, as shown by the testimony of Major Wade and others, and that it is in proof by the complainant's own witnesses, that he did not himself carry the reheating to near so high a degree.

This point was disposed of by Judge Leavitt in the construction which he gave to the patent. I regard that as conclusive at this stage of the case. If an error was committed it must be corrected by the appellate tribunal.

It was also insisted, with no less zeal, that reheating is shown by the testimony to be entirely useless, if not injurious. This point also is in effect disposed of by my learned brother. If this were not so, the defendant could not be permitted to avail himself of this defence. He used reheating in connection with slow cooling before the bill was filed and down to the hearing of the application for a preliminary injunction.

He was then advised by the court that, in their opinion of the case as presented, he was violating the complainant's patent, but was permitted to go on until the final hearing upon the merits, under a bond to account for his profits. He did so go on until a perpetual injunction was granted. The 19,819 wheels were all finished by reheating as well as slow cooling. Under these circumstances

he should be held to be estopped from insisting on this proposition.

The evidence on the subject is contradictory, but every doubt should be resolved against him.

The report of the master, with the single exception before stated, is confirmed, and a final decree will be entered accordingly.

CIRCUIT COURT OF THE UNITED STATES

FOR THE SOUTHERN DISTRICT OF OHIO.

ASA WHITNEY,	FINAL DECREE,
534 *vs.*	*Filed and entered April 5th, 1867,*
ALBERT L. MOWRY.	*Journal N., p. 183.*

This suit having been brought to a final hearing upon pleadings and proofs, and counsel for the parties respectively having been heard thereon, and the same having been duly considered by the Court, it is found and hereby ordered, adjudged and decreed, that the letters patent on which the suit is brought, and which are referred to in the bill of complaint, for an improvement in annealing and cooling cast iron car wheels, granted by the United States to Asa Whitney, bearing date the 25th day of April, 1848, and the extension thereof, are good and valid; that the said Asa Whitney was the first and original inventor of the improvement thereby secured, that the said improvement is useful, and that the Defendant Albert L. Mowry has infringed upon said patent, and upon the exclusive right of the Complainant under and by virtue of the same.

And it is further ordered, adjudged and decreed, that the Complainant do recover of said Defendant, the profits, gains and advantages which said Defendant has received, or which have arisen or accrued to him from said infringement of said patent, by the manufacture, use or sale of cast iron car wheels,

constructed in accordance with the improvement, granted and secured by said patent; and also, that said Complainant recover of said Defendant his costs, charges and disbursements in this suit to be taxed.

And it is hereby further ordered, adjudged and decreed, that it be referred to George R. Sage, Esq., of Cincinnati, who is hereby appointed as special Master of this Court for the purpose, to ascertain and take, and state and report to the Court an account of the gains, advantages and profits which said Defendant has received, or which have arisen or accrued to him from infringing said patent, by the manufacture, use or sale of cast iron car wheels, made by the use of the improvement, patented in and by said patent.

And it is further ordered, adjudged and decreed, that the Complainant, on such accounting, have the right to cause an examination of the Defendant, *ore tenus* or otherwise, and also the production of his books, vouchers and documents; and that said Defendant attend for such purpose before said Master from time to time, all as said Master shall direct.

And it is also hereby ordered, adjudged and decreed, that a perpetual injunction be issued in this suit, against the Defendant Albert L. Mowry, pursuant to and in accordance with the prayer of the bill of complaint filed in this cause.

OPINION.

	Asa Whitney,	
534	*vs.*	In Equity.
	A. L. Mowry.	

Leavitt, J.—The bill alleges an infringement by the Defendant, of the Complainant's patent for improvements in the manufacture of railroad car wheels, originally granted to him on the 25th of April, 1848, and extended for seven years from the 25th of April, 1862.

The answer of the Defendant as first filed, denies the novelty of the Complainant's patented invention, and also denies the infringement charged in the bill. He admits that he has been, and now is extensively engaged in the manufacture of car wheels at Cincinnati, but avers that the wheels are annealed and prepared for use by a different process from that described and claimed in the Complainant's patent; and in accordance with the claims and specification of a patent granted to him, dated the 7th of May, 1861.

By an amendment to the answer allowed by the Court during the hearing, the Defendant sets up as further ground of defense, the want of utility in the improvements patented to the Complainant.

The issues made by the pleadings, are therefore—first, the novelty of the Complainant's invention; second, its utility; and third, its infringement by the Defendant.

These issues will be considered in the order stated. But before proceeding to their consideration, it may be pertinent to remark, that from the great mass of the evidence adduced by the parties, it will be impossible, without an unwarrantable expansion of this opinion, to refer in detail to all the facts on which the conclusions of the Court are based. I have carefully

considered the evidence, as also the extended and able arguments of counsel, and will, with as much brevity as possible, state the results.

First, as to the novelty of the invention patented to the Complainant.

The allegations of the answer assailing the novelty of the patent are: "That in so far as the Complainant in his said Letters Patent, claims to be the inventor of reheating car wheels after their removal from the moulds, or of a continuing process of removing them while at a red heat from the moulds, and without allowing them to cool, placing them in that state in a previously heated furnace or chamber, and there reheating them to a high temperature, and then allowing them to cool gradually; such claim is beyond the invention of Complainant, and his said letters patent are void, for the reason that the same process was known and used long prior to such alleged invention by the Complainant; and the Defendant then specifies more than twenty persons to whom the Complainant's process was known, and by them used in different places in the United States, prior to the date of his patent. He also refers to twenty or more works or printed publications, in this country and in Great Britain, in which it is averred the Complainant's process is described.

Before advancing further in considering the question of novelty, it will be necessary to state at least the outlines of the Complainant's process, as set forth in his specification and claim. In the Patent, the invention is designated as "a new and useful improvement in the process of manufacturing cast-iron railroad wheels."

In his specification, the Complainant calls it "a new and useful improvement in the process of manufacturing cast-iron railroad wheels." And he says, "My improvement consists in taking railroad wheels from the moulds in which they are ordinarily cast, as soon after being cast as they are sufficiently cool to be strong enough to move with safety, or before they have

become so much cooled as to produce any considerable inherent strain between the thin and thick parts, and putting them in this state into a furnace or chamber that has been previously heated to a temperature as high as that of the wheels when taken from the moulds. As soon as they are deposited in this furnace or chamber, the opening through which they have been passed is closed, and the temperature of the furnace or chamber, and its contents gradually raised to a point a little below that at which fusion commences, when all the avenues to and from the interior are closed, and the whole mass left to cool no faster than the heat it contains permeates through, and radiates from, the exterior surface of the materials of which it is composed. By this process all parts of each wheel are raised to the same temperature, and the heat they contain can only pass off through the medium of the confined atmosphere that intervenes between them and the walls of the furnace or chamber; consequently the thinnest and thickest parts cool simultaneously together, which relieves them from all inherent strain whatever when cold." After referring to the drawings descriptive of the furnace, the patentee adds: "To heat this furnace I have used anthracite coal, it requiring less than one-fourth of a ton to anneal two tons of wheels." He also provides for other kinds of fuel for heating the furnace, but declares that by whatever means the heat is produced, the furnace or chamber must be so constructed as that the operator can control the quantity and intensity of the heat used by admitting more or less of it into the chamber, or excluding it entirely.

After stating the advantages of annealing car wheels by this process, as adding to their strength and durability, and as being more economical than any other known process, he disclaims the annealing of castings in the ordinary way, and also says he does not "claim to be the inventor of any particular form or kind of furnace in which to perform the process;" and he adds: "But what I do claim as my invention, and desire to secure by letters patent, is the process of prolonging the time of cooling, in connection with annealing railroad wheels in the manner

above described—that is to say, the taking them from the moulds in which they are cast before they have become so much cooled as to produce such inherent strain on any part as to impair its ultimate strength, and immediately after being thus taken from the moulds, depositing them in a previously heated furnace or chamber, so constructed, of such materials, and subject to such control, that the temperature of all parts of the wheels deposited therein may be raised to the same point, (say a little below that at which fusion commences,) when they are allowed to cool so fast, and no faster than is necessary for every part of each wheel to cool and shrink simultaneously together, and no one part before another." Such is substantially the specification and claim of the complainant, stated in such full, clear and exact terms, as that an intelligent mechanic in that department, according to the testimony of a well qualified expert in the case, could readily follow the process described.

Before referring to the evidence offered as impeaching the novelty of the Complainant's patented invention, it is proper to remark, that the evidence to sustain such a claim must be strong and conclusive to justify a judgment setting aside the patent as void for the want of novelty. The presumption of law is with the Complainant upon this issue, arising not only from the grant of the original patent, but from its extension for seven years after its expiration.

The statute authorizing the extension of a patent is too well known to require special reference or citation. It is sufficient to say that it imposes on the head of the Patent Office the duty of a critical revision of the grounds on which the original patent was granted. He must be satisfied, not only that the invention was new, but that it had proved of great practical utility to the public, and that the patentee had used proper diligence in bringing the invention into public use, and had not been sufficiently remunerated, as the conditions on which alone the patent can be extended. And the statute requires notice of the application for the extension, so that all persons opposing it may have the opportunity of making their objections.

A patent which successfully undergoes this scrutiny without any modification of the original claim and specification, has very strong presumptive claims to validity, as being both new and useful. Another fact strengthening this presumption is, that the Complainant, for eighteen years before the commencement of this suit, had practically and successfully practiced his patented method of annealing car wheels; during which time, as the proof shows, nearly five hundred thousand car wheels were manufactured and sold at his foundry in Philadelphia.

But how does the issue of novelty stand upon the evidence? The Complainant's patent bears date in April, 1848, but it appears his application for a patent dates back to the 2d of August, 1847, which is to be viewed as the date of his invention.

All the witnesses agree that prior to that time, no car wheel made of cast iron was known, having the required qualities of durability and strength. The art of casting in chills, as it is called—that is, casting in a mould, the outer circumference of which was iron instead of sand, was known and frequently practiced. This produced a hardened surface on the periphery of the wheel; but in cooling, the thick and thin parts of the wheel contracted unequally, and the result was an inherent strain between the periphery or tread of the wheel and its inner parts, that greatly impaired the strength and durability of the wheel. Prior to the date of the Complainant's invention, several devices had been resorted to and patented, designed to remove the injurious effects of this inherent strain. The first remedy for this difficulty was, to cast the hub in sections, dividing it into four parts. After the wheel had cooled, and the process of contraction ended, these spaces between the divided parts of the hub were filled with some fused metal, and the hub thus made solid. But this mode involved a waste of time, and was too expensive for practical use. It was found, too, that the wheel was sometimes distorted, so as to be useless. It appears that the next device for avoiding the inherent strain, was to make the plate or thin part of the wheel of a curved form, so that in cooling the curve in the plate would be straightened.

There were also patents for other plans, embodying changes in the shape of the wheels, to overcome the effects of unequal contraction in cooling, and thus avoiding the inherent strain.

But none of these inventors seem to have conceived the idea of making a practical car wheel with straight plates so annealed and cooled, as to leave it strong and durable, and uninjured by the unequal contraction of its parts.

It is safe to say, that up to the date of the Complainant's invention, the process of prolonging the time of cooling the wheel, in the mode described and claimed by him, and thus overcoming the difficulties of the prior methods was unknown. Several intelligent witnesses sustain this conclusion, in a manner that frees it from all doubt.

I have not deemed it necessary to advert to the publications referred to in the Defendant's answer, as anticipating the Complainant's invention. They prove undoubtedly that the process of annealing metals has been long known, and that various plans and modes of accomplishing it have been described by scientific writers. But the evidence is clear, that casting railroad car wheels is a distinct branch of the art of casting, and that none of the printed works referred to, describe or apply to that art.

One witness, examined as an expert, and apparently well acquainted with mechanical science, testifies that in none of those works is the Complainant's process of making car wheels alluded to or described. There is some reference to annealing wheels, other than car wheels, but none to any wheel cast within a chill, and therefore it has no application to the process described by, and patented to the Complainant.

Without enlarging on the question of the novelty of this invention, I have no hesitancy in the conclusion, that the evidence is entirely satisfactory to prove that the process of prolonging the cooling of car wheels, and thus avoiding inherent strains, is due to the thought and inventive talent of the Complainant. And I can not, perhaps, more appropriately close my remarks on this point, than by quoting what was said in relation to it by my learned brother, Mr. Justice Swayne, who sat with me

on the hearing of the application for an injunction, at the last April term of this Court. His remarks on that occasion, show a very intelligent apprehension of the subject, and are very pertinent to the question now under consideration.

The learned Judge speaking for the Court said: "Our impression is, that the patent may be sustained on the ground of a discovery.

Annealing is undoubtedly an old invention, but as applied to car wheels, this patent may be valid as a discovery applied to car wheels. It strikes us, as the case is presented, we may fairly hold, and perhaps are bound to hold, that the patentee and Complainant did discover a mode of overcoming this difficulty (the inherent strain of the wheels,) by his process.

That result is a meritorious one, and we should be inclined at the final hearing, as we are now, to give such a construction to this patent, as will sustain his claim to that invention, and give him the fruits of his discovery. There was no proof that he was not the inventor or discoverer of that art, and the application of that art."

Such were the views of the learned Judge, upon the case as presented, on the application for the injunction. I may add, that the evidence on the final hearing, instead of detracting from the correctness of those views on the question of the novelty of Complainant's invention as covered by his patent, has strengthened and confirmed them. Several reliable witnesses, familiar with the progress of making car wheels from their first introduction in this country, agree in their testimony, that up to the time of this invention, no successful method of making them had been discovered; and that the Complainant's process of prolonged cooling was the first known, which overcame the defects in all wheels previously made. In the language of one witness: "It enabled a better wheel to be produced, at a less cost than had been the case before his invention;" and again, "there was a general confidence felt in regard to their strength as well as durability, which never had been the case regarding other wheels."

2. But, as before noticed, the Complainant's patent is assailed as being void for want of utility in the invention, as described in his specification. The argument urged as sustaining this ground of defence is, that the claim for the discovery of the prolonged cooling of the wheels, after their removal from the moulds, and their deposit in the pit or furnace, is, that the temperature of all parts of the wheels "may be raised to the same point, (say a little below that at which fusion commences,") **** and that the effect of this high degree of heat is, either to destroy wholly the chill of the tread, or so to impair it that the wheel will be practically of no value.

This point is most strenuously insisted on by the counsel for the defendant, and if sustained by a fair construction of the patent, and the evidence as to the result of the application of the Complainant's process in annealing car wheels, will be fatal to his claim in this suit. The want of utility in a patented invention is a valid objection to the patent; but it is well settled that Courts will not inquire astutely into the degree or measure of its utility, and unless it appears the invention is wholly worthless or frivolous, the patent will be sustained. It may also be pertinent to remark on this question, that the presumption of utility arising from the grant of the original patent, its extension by the Commissioner of Patents, and the long and successful use of the patented process, as in the case of novelty, require clear and explicit proof of inutility to justify a judgment declaring the patent void.

With these preliminary remarks, I will state briefly my views upon the point under consideration. It involves obviously a mixed question of construction and of fact. And it is proper, first, to settle what is the fair import and extent of the Complainant's claim as to reheating the wheels when placed in the furnace or chamber.

In the description of his process he provides, after requiring the wheels to be thus placed, that "the temperature of the furnace or chamber, and its contents, be gradually raised to a point

a little below that at which fusion commences." These words are substantially repeated in the claim in a parenthesis, in this form: ("say a little below that (the point) at which fusion commences.")

It must be conceded that this claim, as to the degree of heat to which the wheels are to be subjected, is not stated with the precision and definiteness that is desirable. But it is a settled rule in the construction of patents, that the specification is to be liberally construed, and effect, if possible, is to be given to the claims of the patentee, so as to give him all the benefits of his invention. If, with a fraudulent purpose of concealing the invention, or any material part of it, he omits or erroneously describes any essential element, the patent is absolutely void. But there is no claim or pretence that the Complainant had any such purpose in describing his process. And there is no reason to doubt that in referring to a degree of heat a little below the point of fusion, he indicated the degree which, in the hands of an operator of skill and judgment, would effect practically and successfully the object of his invention.

He avoids the point of incipient or actual fusion, but requires the heat to be a *little* below that point. This expression clearly imports some latitude of discretion in the operator. It clearly does not require that the temperature of the wheels shall be raised to the precise point above which fusion would commence. It must be presumed that the inventor knew, that if the wheels were heated to incipient fusion, or to the degree immediately below, they would be so soft as not to retain their shape or symmetry in their position in the chamber or furnace, and that thus their utility would be destroyed. It is not supposable that the inventor intended what would destroy the very object he had in view, namely: to make a wheel in which the chill of the periphery should be preserved, and the inherent strain from unequal contraction avoided. I am clear that the patent may be regarded as claiming, by the fair import of the words, "a little below the point of fusion," such a degree of heat as is necessary to effectuate the intention of the inventor.

His object was to guard against the point of fusion, and also against a temperature so low that an inherent strain would be produced between the thin and the thick parts of the wheel. He says expressly they must not be allowed to cool, after removal from the mould, to a degree which will cause this strain.

That it was not in the mind, or according to the purpose of the patentee, that the point of the temperature of the wheels should be limited to the exact point, "a little below where fusion begins," is inferable from a clause in the body of the specification, providing that the degree of heat must be left somewhat to the judgment of the operator. Having referred to two plans for the construction of the chamber or furnace, either of which, he says, may be adopted, he adds the clause: "In either case, however, the furnace or chamber must be made of such form, and have such appendages connected with it as to enable the operator to control the quantity and intensity of the heat used, by admitting more or less of it into the chamber, or by excluding it entirely." This seems to imply that a range of degrees of heat was contemplated by the patentee, the highest of which should be a little below where fusion commences, and the lowest above the point where the wheels would be liable to cool to such a degree as to produce inherent strain.

And this was clearly to be judged of and controlled by the operator.

Upon the whole, as a question of construction, I cannot find any sufficient basis for the conclusion that this patent must be held as a nullity, because the patentee has designated the point a little below where fusion begins, as the temperature to which the wheels are to be raised, after being placed in the furnace. So narrow a construction of a patent which has been extensively and successfully used for eighteen years, cannot be sustained. If it were conceded that the effect of the heat, if raised to the point stated, would be to impair the chill of the wheel, or even to destroy it, I should hesitate to pronounce the patent invalid, in the face of the fact, that operatives who have manufactured

wheels under this patent for years, were almost invariably successful in producing car wheels of the most approved and practical character.

It is hardly necessary to refer to the numerous authorities in which it has been held, that in constructing machines, or carrying into effect a process under patents, something must be left to the judgment and discretion of the mechanic or operative, to whom the work is committed. The patentee in his specification, addresses himself to those who are supposed to be familiar with the invention covered by the patent. And if the patentee has conformed to the requirement of the statute, by describing his invention "in such full, clear and exact" terms, as that one skilled in the branch to which it pertains can construct it, if a machine, or carry it successfully into effect if a process, his patent is sustainable.

It is hardly necessary to refer at length to the evidence offered by the Defendant, to prove that car wheels annealed strictly according to the process claimed and described in the Complainant's specification, would be so far deprived of their chill as to render them useless.

There are several witnesses who state it as their opinion, that if the wheels are raised to a temperature when placed in the furnace, a little below the point of fusion, the chill would be impaired or wholly destroyed. These opinions, however, are based on mere speculation, and not the result of actual experiments in annealing car wheels. Some of these witnesses have evidently misunderstood the claims of this patent. One seems to suppose it requires the wheels to be heated to "incipient fusion," and another speaks of them as in a "semi plastic" state. Both are evidently mistaken as to the calls of the patent in this regard.

One witness—Renwick—a very learned expert called by the Complainant, gives it as his opinion on his cross-examination, that if the wheels when placed in the furnace were subjected to a long continued heat, a little below the point of fusion, the effect would be to seriously impair the chill.

But the patent does not contemplate that they shall remain for any length of time at this high heat. On the contrary, it is distinctly stated in the specification, that as soon "as all parts of the wheel are raised to the same temperature" * * * "all the avenues to and from the interior are closed, and the whole mass left to cool no faster than the heat it contains permeates through, and radiates from the exterior surface of the materials of which it (the furnace) is composed."

From the heat required in the furnace when the wheels are placed in it, it is obvious that but a short space of time will be required to produce the equability of temperature; and this being effected, the process of cooling immediately commences.

It is by no means clear, from the evidence, if the claim of the patent requiring the wheels to be heated to a point a little below where fusion commences, is construed with the strictness claimed by the Defendant's counsel, that the effect would be to destroy the chill, and thus impair the utility of the wheel. Several witnesses familiar with this process from the date of Complainant's patent, testify that in his extensive foundry, wheels have been made and annealed in exact accordance with the patent, and without any change or modification. If this is the fact, it negatives conclusively the inference that the patented process, whatever construction is given to the claim, is injurious to, or destructive of the chill of the wheel.

But if the views stated on this point and in conclusion are erroneous, there is another ground on which the claim of Defendant's counsel, that the patent is void for inutility, must be overruled.

It is apparrent from the specification, that the preservation of the chill of the wheel, by the process of annealing described, is not the only object deemed important, and sought to be attained by the patentee.

The prevention of any inherent strain, is claimed as part of the invention. And the witnesses who express the opinion that the high heat required for the wheels must impair or destroy

the chill, say that the inherent strain would be prevented. The result would be, upon their theory, that while the tread of the wheel would be too soft for durable service, it would not be worthless, and would have at least the merit of being free from any inherent strain. The wheel would not be as valuable as it would be upon the supposition that the periphery was so far hardened by the chill, as to make it more durable and useful, but the removal of the strain would impart to it a degree of utility sufficient to sustain the patent.

But it is not necessary further to pursue this branch of the case. I am clear in the conclusion that neither upon the law or the facts is the defence of the want of utility in this invention so made out, as to require the judgment of the Court that the patent is void on that ground.

3. The remaining issue to be disposed of is, whether the Defendant has infringed the exclusive right of the Complainant under his patent. The infringement is denied in the answer, and the *onus* of proving it is on the Complainant. The answer avers that the defendant has not manufactured or sold car wheels "which have been subjected to the treatment or process described or specified in said Letters Patent of the Complainant, or to any process or treatment substantially or practically similar in its nature or its effects." The Defendant also avers in his answer, that he was the first and original inventor of certain improvements in annealing car wheels, for which he obtained Letters Patent, dated the 7th of May, 1861. And he avers "that he has manufactured and annealed car wheels according to the process described in his said Letters Patent, and not otherwise."

It may be well to notice here, that neither the Complainant or the Defendant claims, as a part of his invention, the form or structure of the furnace or pit in which the wheels are annealed.

The Complainant says, in his specification, "nor do I claim to be the inventor of any particular form or kind of furnace in which to perform the process."

The Defendant says: "I do not claim as my invention, or any part thereof, the pits, flues, or currents of air, for the purpose herein described."

The question of infringement is therefore limited to the inquiry, whether there is a substantial identity between the processes of annealing car wheels, as patented to, and used by, the parties respectively, under their patents. The process of the Complainant, as embodied in his patent, has been noticed before, and need not be repeated here. The Defendant, in his claim, says: "What I claim as new, and desire to secure by Letters Patent, is: The employment of charcoal, or other equivalent combustible substance, interlaid between the wheels in a pit, in combination with an aperture for regulating the supply of air to the same to prolong the combustion of the fuel, and retain the heat for the purpose herein described." In the second paragraph of his specification he describes the character of his invention substantially as embodied in his claim just quoted, but with more particularity.

He there says: "The purpose of the charcoal interlaid with the wheels, is to heat the wheels in the pit to a proper temperature, prolonging the heat, and permitting them to cool gradually in a given time," elsewhere stated to be about seventy-two hours. In another place he states: "The operation of my invention is as follows: a layer of charcoal having been placed in the perforated bottom of the annealing pit, the wheels, as they are turned out of the moulds red hot, are placed in the pit, with a layer of charcoal between each wheel, a layer of charcoal being laid on the uppermost wheel, and on this a perforated metal plate is placed; the charcoal being now ignited by the hot wheels, the cover of the pit is then laid on, and the damper opened so as to admit just sufficient air to effect the combustion of the contained charcoal." In further explaining his process the Defendant says: "It is well understood that chilled car wheels require to be cooled by a process which will permit the different parts to adjust themselves to each other, and accom-

modate the unequal contraction which results from the process of chilling."

A comparison of the claims and specifications of these patents, shows clearly that both had the same object in view, namely: Annealing car wheels by a proper increase of heat after they were placed in the pit or furnace, and providing for their gradual and prolonged cooling, so that when cooled the tread or periphery should be of suitable hardness, and the strength of the wheels not impaired by the strain resulting from the unequal contraction of the parts. The issue in this case, on the question of infringement, seems therefore to be reduced to this inquiry, whether these patentees accomplish by the annealing processes which they describe and claim, the same result by substantially the same means.

The law applicable to identity is so well settled and understood, that it is useless to extend this opinion by the formal citation of authorities. It is a conceded principle, that a patent for a mechanical structure, or a process to effect a specific purpose, does not embrace every possible means of effecting the same result.

The true inquiry is, whether the machine or process charged to be an invasion of an exclusive right of a patentee, embodies the idea or conception of the original inventor, and accomplishes it by substantially the same means. A patentee is protected from the use of all plans or devices, which however seemingly different from the patented invention, are the same in principle and operation.

This is a question of fact to be decided by the testimony, and to that I will briefly refer; remarking that the only points really in controversy are: First, Whether the Defendant provides for reheating the wheels, when removed from the moulds to the furnace or pit. Second, Whether he claims the process of prolonged cooling as a part of the invention, and Third, Whether his method of heating the furnace or pit is substantially the same as that described by the Complainant.

On these two points, I need not again refer to the claims of the two patents, as they have been already cited.

The reheating of the wheels in the pit, and the prolonged cooling after being heated to the proper temperature, are clearly claimed by the Defendant in his specification, as elements of his process. The Complainant heats the furnace previously to the wheels being placed in it, by the combustion of anthracite coal or other suitable material; the Defendant reheats by placing charcoal at the bottom of the pit, to be instantly ignited by the first red hot wheel deposited, and then placing a layer of charcoal on each successive wheel; thus producing what one witness calls an "incandescent mass" in the furnace, and heating the whole to a high temperature. It was well and pertinently remarked by Judge Swayne, on the hearing of the application for an injunction in this case, after a critical comparison of both patents in reference to the specification of the Defendant, that there were "very numerous analogies, though the collocation was a little different."

It has been noticed in a previous part of this opinion, that one of the Defendant's counsel strenuously insisted in his argument, that there was a palpable difference in the practical operation of the processes claimed by these parties in this, that if the specification of the Complainant's patent is strictly followed, a wheel is produced with its chill so far impaired or destroyed, as to render it useless; and that therefore the Defendant's process is dissimilar, as its result is a perfect and practical wheel.

This point is disposed of by the construction given to the Complainant's patent, to the effect that he does not require or provide for a reheating of the wheel, to an extent which destroys its usefulness.

On the question of the identity of the two processes, a number of witnesses have testified on both sides. I have examined their evidence with care, but cannot, without an unwarrantable extension of this opinion refer specially to it, or analyze the views and statements of the different witnesses. There is un-

doubtedly some conflict in the evidence on this point, but in my judgment, that which sustains the substantial identity of the processes of the Complainant and the Defendant, greatly preponderates.

The Defendant's witnesses say they are different, because the Complainant provides that the furnace or chamber in which the wheels are placed after being taken from the moulds, is previously heated to a high temperature; while by the Defendant's process, the furnace or chamber is not heated when the first wheel is deposited, and becomes gradually heated as each wheel is placed in position. Some express the opinion, from what is a clear misapprehension of the description of the Defendant's process, that there is no reheating of the wheels after being removed from the moulds. Others again, think there is no claim by the Defendant for the prolonged cooling of the wheels, as provided for in the Complainant's specification. And others say, the heat of the wheel by Defendant's process, is not the same in all its parts; that the hub and rim of the wheel lose heat, while the temperature of the plate only is raised in the furnace or chamber. There are also, perhaps, some other points of disagreement stated by some of the witnesses, to which I have not adverted.

But all the evidence of this character seems to be fully met by the views and opinions of the experts who testify for the Complainant. They are believed to be entirely truthful and reliable, and certainly evince a high degree of intelligence with reference to the subjects to which their attention is directed. One witness says: "In my opinion the process of annealing car wheels, set forth in said Mowry's patent, is in substance a variation or modification of the process described in the said patent of the Complainant; the process in said patent (Mowry's) embodying in substance the whole of the process described in said patent of the Complainant, and the variations consisting in the use of a particular fuel, (charcoal,) and of a furnace specially adapted to the employment of such fuel, for the purpose

of increasing the temperature of the wheel." He then states at length his reasons for this conclusion, saying at the close of his statement, "Although these differences constitute a variation in the mode of practicing the process, they do not so change it, in my opinion, as to make it substantially different from the process described in said Complainant's patent."

Another witness says: "I regard said apparatus of Mowry, in its principle, mode of operation, and construction, as substantially identical with that patented to Whitney. I think that the processes are the same." This witness also states, that the only difference between the two, is in the mode of heating the wheels after being placed in the chamber or furnace, and that this is only a formal difference.

A witness, who appears to have had much experience in making car wheels, and to be well acquainted with the business, speaking of the processes of the Complainant and Defendant, says: "I believe them to be substantially the same in principle, mode of operation, and effect produced."

Another witness testifies, that "the process described by the Defendant is identical in operation and results with that patented to the Complainant, both taking red hot wheels before they are injured by contraction in cooling, putting them in a furnace, chamber or pit, then raising the temperature of the wheels to a uniform degree throughout, and then permitting them to cool slowly, that when cold no strain is left upon them by unequal shrinking." The Complainant, as a witness, swears: "the only difference, in my opinion, between my process and that of Mr. Mowry, is that incident to the different fuels used by each: the effect is the same in both cases."

The evidence seems to be very conclusive, that the two processes are substantially identical, and that the variations in the mode of using them are merely formal, and do not imply a difference in principle. The conception embodied in the invention of the Complainant is most clearly reproduced in the patent of the Defendant. And if it were true, as contended by the De-

fendant's counsel, that his process produces a more perfect and valuable wheel than that of the Complainant, it would not protect him from liability for an infringement, if he adopts substantially the essential elements of the original invention. If he was the inventor of an improvement, new and useful, it was properly the subject of a patent, but would not authorize him to appropriate as his own the invention of the Complainant.

The law on this subject is well settled by numerous adjudications of the Courts of the United States.

Without quoting at length the decisions of these Courts, on this point, I will merely refer to the cases in which the principle is involved. Winans *vs.* Denmead, 15 How., 342. Goodyear *vs.* Railroad, 2 Wallace, Jr., 361. Goodyear *vs.* Day, Law's Dig., p. 363, § 22. McCormick *vs.* Seymour, 2 Blatchford, 245. Sickels *vs.* Borden, 3 Blatchford, 542. Tilghman *vs.* Mitchell, decided by Judge Nelson—reported in pamphlet.

It is my conclusion that the issues of novelty, utility and infringement, are all with the Complainant, and that a decree must be entered in his favor.

United States Supreme Court.

ALBERT L. MOWRY, *Appellant,*

vs.

ASA WHITNEY, *Appellee.*

IN EQUITY.
No. 148.

ON APPEAL FROM THE CIRCUIT COURT OF THE UNITED STATES FOR THE SOUTHERN DISTRICT OF OHIO.

ABSTRACT OF THE RECORD.

Burt & Co., Prs., 37 and 39 S. Third St., Phila.

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United States Circuit Court,

SOUTHERN DISTRICT OF OHIO.

ASA WHITNEY,
vs.
ALBERT L. MOWRY.

In Equity.
No. 534.

ABSTRACT OF PLEADINGS AND AFFIDAVITS.

THE BILL OF COMPLAINT alleges:

1st. Invention by Complainant of a new and useful "process for prolonging the time of cooling in connection with annealing cast iron railroad car wheels," and grant to him of Letters Patent therefor, dated April 25, 1848, numbered 5531.

2d. That Complainant has been continuously engaged, ever since grant of Patent, in manufacture of wheels by said patented process; that he has so made large numbers of wheels and extensively introduced same, and has been for eighteen years in undisturbed, exclusive possession, use and enjoyment of rights under said Patent, and but for the infringement by Defendant would have been able greatly to extend his manufacture and sale, and have had correspondingly enlarged profits therefrom.

3d. Infringement by Geo. H. Thacher, of Albany, and suit against him July, 1855, therefor; application by said Thacher for settlement, and settlement pursuant to such application.

4th. Application in due form for extension, and grant thereof extending said Patent for seven years from and after April 25, 1848.

5th. Infringement by Defendant to the damage of Complainant and profit of Defendant.

Prays provisional and perpetual injunction, with decree for damages sustained by Complainant, and profits derived by Defendant.

Copy of the Patent annexed to bill, and certificate of extension endorsed thereon.

Affidavit of Asa Whitney.

Close Monopoly of Patent.

Avers that affiant is Complainant, and has kept the right under his Patent,

"exclusively and solely for my own use and enjoyment, and wish still so to do during the remainder of the term for which such Letters Patent have been extended, believing that I have furnished and can still furnish to the public a better wheel at the same price than can be made by any other process, or by any other manufacturer using my process."

Alleges that he never granted but two licenses, one in 1849 and another in 1851, both of which were soon after cancelled, and since then has refused to grant any licenses.

Alleges former suit against Defendant, and its discontinuance for reasons set forth, and bringing of present suit.

Alleges great damage to his business, &c.

Affidavit of George H. Knight.

Rec., p. 12.

Gives description of the pits employed by Defendant, and of his process, with diagram.

Affidavit of same.

States that he is a resident of Cincinnati; a Consulting Engineer and Solicitor of Patents, and is familiar with the principles involved in the art of casting metals as now practised.

States that a subsequent inspection of Mowry's process, shows that his, affiant's, former affidavit was not wholly correct; annexes corrected sketch of Mowry's pits and appliances. (Referred to and set forth in deposition of Geo. H. Knight, hereinafter embodied.)

Difficulties encountered in making car wheels, and process used prior to Whitney.

Says has read and understands the Complainant's Patent; that at time of Whitney's invention numerous experiments had resulted in the adoption, for railway carriages, of the cast iron wheel as now prevalent. Refers to the liability of such wheels to fracture from unequal tension of its parts in the act of cooling.

Slow cooling by covering with sand.

"The defect alluded to had been sought to be remedied by the ordinary process of annealing in which the heat incident to casting is retained by an envelope of sand or other slow conductor. This, as is well known, proved inadequate, and it is believed that Mr. Whitney, in his process thus patented, was the first to effect the complete annealing of the car wheel, without impairing the 'chill or the strength of the wheel."

The deponent further proceeds to state his reasons for the conclusion which he arrives at, that Mowry's process is an infringement on Whit-

ney's Patent, the course of reasoning being the same as set forth in the deponent's depo. ition, taken at a subsequent stage of the cause, and hereinafter abstracted.

Affidavit of Coleman Sellers.

Rec. pp. 15-17.

Resides Philadelphia; occupation, Mechanical Engineer; has examined Whitney's Patent, and is familiar with his process as practised under said Patent.

Speaks of the effect of casting against a "chill" upon the wheel in its mould, the sudden shrinking caused thereby, &c.

Has read Knight's affadavit of Feb. 28, 1866, describing Mowry's process, and considers said process substantially same as Whitney's.

Affidavit of Edward S. Renwick.

Rec., pp. 18-19.

Resides New York, Consulting Engineer, Solicitor of Patents, and Scientific expert.

Has read and examined Whitney's Patent, and also Knight's affidavit of Feb. 28, 1866.

Finds that the two processes are substantially the same.

* * * * * * * * * * *

The *discovery* on which Whitney's Patent is based.

"The process pursued by Mowry and Whitney is, in fact, based upon the discovery which, so far as I know, was first made by Whitney, viz: that the chilled cast iron, constituting one part of the wheel, could be subjected to a heat less than fusion, without producing any material effect upon its hardness; while the cooling of the remainder of the wheel could be so prolonged by the application of heat derived from burning fuel, as to enable all parts of the wheel to cool without being subjected to the strains incident to unequal contraction."

AFFIDAVIT OF A. L. MOWRY.

Rec., pp. 20-21.

Refers to Letters Patent, issued to him May 7, 1861, for improved mode of annealing car wheels, and annexes copy of same.

That he has practised said process at his works.

Refers to Whitney's Patent, and describes his process as understood by deponent, also his own process, and points out in detail the distinctions between the two, in effect, that no re-heating, except the plates, in deponent's process; that the hubs lose heat rapidly from the time the wheels are placed in the pit; that the several parts of the wheels in deponent's pits are not heated to same degree, nor to a point approximating the "point of fusion;" if they were so the "chill" would be ruined and the wheel rendered unfit for use. That deponent does not

use charcoal by reason of its cheapness as compared with the cost of other kinds of fuel, since it is more expensive, but by reason of its chemical effect on the iron.

Affidavit of George H. Thacher.

Car-wheel manufacturer at Albany.

Rec., pp. 23-24. States that he is acquainted with the processes of Whitney as described and claimed in his Patent, and Mowry, respectively, and describes same. Expresses the opinion that the processes are essentially different from each other.

"1st. Whitney places his wheels in an oven heated previously to its receiving the wheels; Mowry uses a pit not previously heated, but entirely cold. 2d. Whitney claims the raising the temperature of the wheels after being placed in the oven to a point a little below the point of fusion. Mowry does not claim to do this, nor can he raise the temperature to so high a point unless he changes his process. 3d. The raising the temperature to a point a little below the point of fusion is, in the judgment of this deponent, a positive injury to the texture of the iron and the strength and durability of the wheel. 4th. The taking the wheels in a heated state from the mould is common to all processes of annealing. It has been done ever since cast iron wheels were made, whether they were cooled in dry sand or in any other process."

THE ANSWER OF A. L. MOWRY.

Admits the grant of Letter's Patent to the Complainant Whitney, April 25, 1848, and the due extension thereof.

Also that Complainant has been engaged for many years in the manufacture and annealing of car wheels, but by what process Defendant does not know.

As to the suit against Thacher, the Defendant avers on information that said Whitney applied for a settlement thereof because he became convinced that he could not, in view of the testimony taken therein, risk the result thereof, and that a settlement was made whereby Thacher paid a small sum, less than the cost of said suit, and was not made by way of compensation for an admitted infringement, but as involving a less outlay than would have been the expense of said Thacher had said suit been continued, even in the event of success to him; that no judgment was recovered against said Thacher.

Denies making or annealing of car wheels in violation of Complainant's Patent, or by the process therein described and claimed.

Alleges grant to Defendant of Letters Patent dated May 7, 1858, for

certain improvements in annealing of car wheels, and that Defendant has annealed car wheels according to said process patented to him. (Annexes copy of said Patent.)

Alleges differences between process as patented to Complainant and that practised by Defendant, as follows, to wit:

1. That wheels in Complainant's process are removed from moulds to a previously heated oven, heated to same temperature of the wheels when placed in it, while in Defendant's process they are removed to a cold pit.

2. In Complainant's process all parts of the wheels are reheated to a point a little below that at which fusion commences; while in Defendant's process all parts of the wheels are not similarly or approximately affected by the heat, nor is any part of the wheels, respectively, reheated to a point at all approximating the point of fusion; if, indeed, the temperature be at all increased, which is not believed to be the case. During the time the wheels remain in the pit, in Defendant's process, the hubs are kept cooler than the plates by a current of cold air which passes through them, and the different parts of the wheels do not simultaneously cool.

Describes Defendant's process as follows, to wit.

"The process practised and used by the Defendant in the manufacture of car wheels is as follows: The wheels are taken red hot from the moulds in which cast, and are placed in an annealing pit with a layer of charcoal between each wheel, a layer of charcoal being laid on the uppermost wheel, and on this a metal plate is laid; the charcoal becoming now ignited by the hot wheels, the cover of the pit is then laid on, and a damper opened so as to admit just sufficient air to effect the combustion of the contained charcoal in the space of about seventy-two hours; the draft of air so introduced passes downwards through the eyes or hubs of the wheels; on the top of the wheels is placed a lid or cover, and projecting above this and below it into the hubs of the wheels is a pipe for the purpose of conducting the current of air into the hubs of the wheels; in order that the combustion of the charcoal may be prolonged in the bottom of the pit, is also placed a perforated plate.

And further answering, the Defendant states, that long prior to the date of the Complainant's Letters Patent, and of his alleged invention, the brittleness which is occasioned by the unequal contraction of metals when rapidly cooled was perfectly known and understood; and that long prior to the alleged invention of the Complainant, glass and metals which had been cast and formed in moulds, were, for the purpose of preventing brittleness and preserving the texture of the material, removed from the moulds in which cast, at a red heat, and immediately placed in previously heated furnaces or ovens, and there re-heated to a high temperature, and then allowed to cool gradually, such process being termed *annealing*."

Alleges invalidity of Complainant's Patent by reason of want of novelty of the process claimed by him therein, and sets up names of

a number of persons possessing prior knowledg., and having made use of similar process, with places where same was used.

Also sets up sundry publications of date prior to Complainant's invention, describing similar processes to that claimed by Complainant.

(These references, so far as supported by testimony, will appear in the abstract of proofs.)

AMENDMENT TO ANSWER.

"And the Defendant denies that the alleged invention of the Complainant is useful; but on the contrary, the Defendant asserts that the process described and claimed in the said Letters Patent is positively useless and injurious, inasmuch as the said process would ruin and destroy the hardness on the rim of the car wheel known as the 'chill,' and thus greatly detract from the usefulness and durability of the wheels."

Replication to Answer, as amended in usual form.

ASA WHITNEY
vs.
ALBERT L. MOWRY. } In Equity.

ABSTRACT OF COMPLAINANT'S PROOFS.

George H. Knight's Testimony-in-chief.

Age forty-six; residence, Cincinnati; occupation, Consulting Engineer and Solicitor of Patents.

Printed Rec., pp. 37–43.

Has read and examined Complainant's Patent and understands same; thinks description in specification remarkably clear; has also examined and understands mode of annealing cast iron car wheels as practised by Defendant at his manufactory at Cincinnati.

Describes Mowry's process—the removal of the wheels red hot from their moulds, and their deposit in a pit; a layer of charcoal on bottom of pit and on top of each wheel; the pit provided with bottom grating with flue communicating with smoke box; an iron plate covers the pit with central aperture, and through this projects a small pipe, its lower end resting in opening in hub of wheel; the charcoal ignites by contact with hot wheels.

Complainant's Exhibit "C" Sketch of Mowry's pit.

Annexes sketch of Mowry's pits—Complainant's Exhibit "C."

"Q. 5. Please to state the purpose and effect of the apparatus employed by Whitney and Mowry.

Purpose and effect of Whitney & Mowry to anneal the wheels without impairing the "chill."

"A. The purpose and effect is in both simply to anneal that part of the wheel situated within the chill, without materially impairing the latter. This result, Whitney discovered he could accomplish, so as more perfectly to anneal the wheels without materially impairing the chill, by the use of external heat over and beyond the heat of the wheel, the previous mode of annealing the wheels having been to prolong the cooling of the wheels merely by heating sand or other slow conductor around them."

Gives dimensions of Mowry's pit.

"Time occupied in process am informed was about four days."

Cross-Examination.

Q. 1–10. Relate to effect of application of heat to castings of unequal thickness of parts.

Q. 10–27. States that in Mowry's process the wheels at first part with heat to the walls of the pit and to the charcoal; that afterward the wheels are "surrounded by flame and incandescent masses of charcoal to a high degree of heat;" that he does not know whether the effect of the two processes (Whitney's and Mowry's) is the same on the wheels, not having experimented on the subject.

"Q. 27. Do you know the process of annealing car wheels in use anterior to Whitney's invention?

A. I know of the use, anterior to his invention, of sand for the purpose of retaining the heat of the casting, and permitting the crystallization to proceed slowly."

* * * One way was to envelope the wheels as they lay in their moulds; I think this was the mode generally resorted to, to the best of my recollection. Another mode, however, was, immediately after removing them from the moulds, to cover them with sand or loam, the purpose, in both cases, being to prolong the process of cooling."

Coleman Sellers' Testimony-in-chief.

Printed Rec., pp. 44-57.

Age, thirty-nine; residence, Philadelphia; Mechanical Engineer; have been acquainted with the manufacture of car-wheels for sixteen years; for ten years have been quite familiar with the process patented by Mr. Whitney; have read Whitney's and Mowry's Patents; also description given by Knight of Mowry's process, and understand same.

Thinks Whitney's & Mowry's processes the same.

"I think the processes are the same (Whitney's and Mowry's). In Whitney's, the wheels, while still at a red heat, are removed from their moulds, and placed in a pit prepared for their reception, and there subjected to such a degree of heat as shall equalize the strains produced by the unequal cooling of the casting in the mould, after which the pit, being closed, is allowed to gradually cool with its

charge of wheels, &c. Then describes Mowry's process. * * * * Thus in both cases there is an equalizing of the strains by this after heating in the pit; and the slow cooling of the pits in both cases must bring the wheels, when cold, to nearly the same condition.

"Q. 7. In speaking of the wheels, after being placed in the pit prepared for their reception, being subjected 'to such a degree of heat as shall equalize the strains produced by the unequal cooling of the casting in the mould,' what degree of heat do you indicate, relative to the temperature of the wheel, when removed from the mould?

"A. If the wheel be reheated until all parts of the wheel be of the same temperature as the hottest part of the wheel at the time of its removal from the mould, and provided the wheels be removed from the moulds at as high a degree of temperature as is consistent with their safe removal, the strains incident to irregular cooling in the mould, I think, would be in a great measure equalized."

The only difference between Whitney's and Mowry's processes is in the manner of heating the pits.

Cross-Examination.

Rec., Printed, pp. 47-56.

State of the art prior to Whitney's Patent.

"The advantage to be derived from prolonged cooling was known previous to the application of Mr. Whitney, so far as is still customary in all founding operations, as, for instance, covering up with sand or other non-conducting material, and in some cases, moulds have been enclosed in cases, to prevent the too rapid passing off of the heat; but in all casting operations where the form to be made is very irregular, even such prolonged cooling fails to remove the strains incident to such cooling, the cooling of each separate part proceeding *pro rata* with its first cooling action. To compensate for this, it was usual, previous to Mr. Whitney's invention, and is still practised, to uncover certain portions of the mould, and thus hasten the cooling of that part, while other portions of the castings were kept hot by being surrounded by non-conducting materials."

* * * * * *

"This was not the only mode of annealing castings known at the time specified: at the time of his application, cold castings of metal had been reheated for the purpose of annealing or softening: castings, other than metal, had been treated by removing in a red hot condition from the mould, and placed in a previously heated furnace, for the purpose of annealing, but such process was not, to my knowledge, used in castings of metal.

Does not know of any case prior to Whitney's Patent in which castings of *metal* were taken in red hot state and placed in previously heated ovens.

"I do not know of any case prior to the time specified (the date of Mr. Whitney's application) in which castings of metal were taken in a red hot condition, or at a high heat, and placed in a previously heated chamber, oven or pit, for the purpose of equalizing the strain in the various parts of the castings, incident to irregular cooling in the mould, nor for the purpose of prolonging the cooling."

Q. 6. "In your opinion, then, is that part of Mr. Whitney's process of taking the castings at a red heat from the moulds, and placing them in a previously heated chamber or pit, for the purpose of prolonging the time of cooling, simply new?"

"A. I do not think that that in itself is a novelty, irrespective of the temperature to which the pit has been previously heated."

Whitney's furnace not essentially different from annealing furnaces used prior to his Patent.

Whitney's furnace is different in form, but not in its essential features, from furnaces used for annealing, previous to his Patent.

+ Q's. 9 to 45 relate to supposed difference in details of the two processes, manner of heating, kind of fuel; Mowry's pit not being "previously heated," &c.

The witness affirming his testimony-in-chief, that the differences are not substantial, and that the processes are substantially the same.

Whitney, in practice, raises the temperature "to a certain degree," but how high witness does not know

"+ Q. 45. In Whitney's process, after the wheels are deposited in the furnace or chamber, the temperature of the furnace or chamber, and its contents, is raised to a point a little below that at which fusion takes place, is it not?

"A. In Mr. Whitney's Patent the words occur as quoted in the question; and in the process, as used by Mr. Whitney, to the best of my belief, the temperature of the furnace or chamber is raised to a certain degree, but whether or not it be a few degrees below that heat at which fusion commences, I am not able to say.

Does not know the exact temperature employed by Mowry.

"I do not know the exact temperature to which Mr. Mowry raises his wheels in this part of his process."

If in Whitney's process the temperature is raised very nearly to fusion, and in Mowry's it is not raised to "nearly so great a degree," "there would be a difference of degree and not of essence."

In Whitney's process, all parts of each wheel are raised to same point, and all parts cool simultaneously.

If in Mowry's all parts are not raised to same temperature, the rims and hubs bseing at all times a little cooler than the thinner parts, the two processes would differ in degree and in result; Whitney's wheel being free from strain when cold, and Mowry's containing strains caused by unequal contraction.

"The stage of the process (Whitney's) at which the avenues (to and from furnace) are closed, is, when in the judgment of the man in charge of the furnace, the wheels have been heated to a sufficient degree and for a sufficient length of time; then the dampers are closed, and if they be kept closed until the wheels are cold, the cooling operation will continue at a regular or uniform rate; but in my former answer, I meant that the dampers being devices under the control of the workmen, they could be used to regulate the rapidity of the cooling, which would nevertheless be uniform to a degree in all parts of the pit and its enclosed contents."

Re-Examination.

Printed Rec. pp. 56-57.

"Previous to the time specified (Aug., 1847,) processes for annealing castings of metal were confined to the covering or protecting of the cooling casting by some non-conducting material, or, in some cases, piling fuel, generally charcoal, or some

More as to *state of the art* prior to Whitney's Patent; processes for "*annealing*" confined to covering the castings with some non-conductor or igniting fuel on some parts of same.

easily ignitable fuel upon some particular part of the casting which it was desired to keep hot for a longer period of time than other portions of the same castings.

"Cold castings have been submitted to the action of fire for the purpose of annealing, as the term annealing has been understood, within my recollection.

"My familiarity, to a degree with annealing processes, began when I was a child," &c. &c.

James Dougherty's Testimony-in-chief.

Printed Rec. pp. 58–61.

Age 50; residence, Philadelphia; Machinist and Founder.

Was engaged in manufacture of car wheels in 1837, and am inventor of the double-plate car wheel, patented 1838. Prior to that invention, my attention was called to the breaking of the wheels, as then made, with arms and the hubs separated to allow their cooling in the process of casting without breaking. My wheel, provided with two plates or discs, forming a continuous support between the tread and hub, and provision made for contractions to take place without injury to the wheel.

No successful car wheel with plates or continuous support between rim and hub prior to my invention; prior wheels in successful use were spoke and arm wheels with separated hubs.

I continued for some years in the manufacture of car wheels.

Effect of contractions was to strain or break the wheel; the chilling of the wheel cooled the periphery more rapidly than the arms or other supports.

A. 6. At time of my invention, and afterwards, manufacture of cast iron car wheels was not a distinct branch of iron founding.

A. 7. As a branch of casting it was distinct.

A. 8. Up to 1848, distinction continued; any one speaking of cast iron car wheels understood them to be wheels cast in chills.

Up to 1848 the difficulties mentioned had, to some extent, been overcome by various forms given to the wheels, such as curving the interior structure, making lines longer than straight lines. Very many forms employed. This was only mode in which there was any success up to that time, so far as I know.

"The mode discovered and used by Mr. Asa Whitney did overcome the difficulties of casting, and enabled founders to cast any form of wheel, when treated, after being cast, as provided in his mode."

Refers to mode as described in Whitney's Patent.

Whitney's processes highly useful.

"I consider it one of the most useful and valuable discoveries made in connection with car wheels."

"The mode of treatment by Mr. Whitney enabled him, or others using such mode, to make the wheels more successfully; furnishing better and safer wheels than made by former modes."

Have read Mowry's Patent and Knight's deposition.

"As I understand the processes, the results of treatment by the processes of Mr. Whitney and Mr. Mowry are the same. Whitney's and Mowry's processes essentially the same.

"The exact modes of treatment differ somewhat; Mr. Whitney placing the wheels in a previously heated chamber, and Mr. Mowry placing them in a chamber which becomes heated by fuel placed between the wheels, over and below them.

"There may be some other minor differences in regulating and controlling the cooling." * * * * *

"As I understand them, these differences are not essential; each process producing the same results, or substantially the same."

Cross-Examination.

I first knew of car wheels cast with chilled rims in 1836: cast them myself in 1837. Printed Rec., p. 61.

First knew of Whitney casting them in 1848.

Enoch Lewis' Testimony.

Age 44; residence Philadelphia; Purchasing Agent for Pennsylvania R. R.; connected with said R. R., since 1850, as foreman of machine-shop, Division Superintendent, &c., and am familiar with equipment and working of railroads. Was employed by Eastwick & Harrison in 1844, in constructing rolling stock of St. Petersburgh and Moscow R. R., in which a large number of cast iron railroad wheels were employed. Printed Rec., pp. 61–66.

Since 1850 have been familiar with the manufacture of wheels at the establishment of A. Whitney & Sons, also with manufacture of wheels at Altoona, and with the use of cast iron railroad wheels in large quantities on that road.

The manufacture of cast iron railroad wheels is a distinct branch of iron founding, use of iron possessing chilling properties being necessary, and to remove the strain caused by the chill, a peculiar process of cooling being necessary.

In this country, for more than 30 years, the term cast iron car wheels meant chilled wheels. It has been a separate and distinct branch of iron founding for 18 to 20 years.

The difficulties which existed, by reason of unequal contraction, prior to 1848, have been

Difficulties caused by unequal contraction entirely overcome by Whitney's process of prolonging the time of cooling.

"Entirely overcome by Mr. Whitney's process of prolonging the cooling of the wheels, which first came under my notice about the year 1851."

Whitney's process as described in his Patent, and as practised by him fully agree.

Have read Whitney's Patent, and the process therein described agrees fully with the process as practised by him.

Have read Mowry's Patent and Knight's deposition, and believe Mowry's process to be substantially the same as Whitney's.

Consider Whitney's process to be one of great usefulness and value; it enabled a better wheel to be produced at less cost than had been done before his invention.

Cross-Examination.

Mowry's and Whitney's processes substantially the same.

Printed Rec., pp. 63-4-5.

+Q. 2. The principle, then, involved or embraced in Mr. Whitney's Patent, of annealing castings by prolonging the time of cooling, permitting the thick and thinner parts to adjust themselves to each other during the process of cooling, was not new or original with him, was it?

A. I cannot say that it was. * * * *

I do not think it was.

* * * * "In answer to the second part of the question it might be said that Mr. Whitney's plan was an application of a principle already known."

* * * * * *

"The mode of the application, and the application of it to the purpose to which he applied it; I consider both novel."

Think Mowry's & Whitney's processes not substantially different in the particulars referred to in questions (+7-10).

+Q. 11. While the effect may be the same, are not the means used to produce that effect essentially different?

A. The means used are different.

Re-Examination.

"I do not think the difference named constitutes any substantial difference in the process."

George Whitney's Testimony.

Printed Rec., pp. 66-68.

Age 46; reside in Philadelphia; I am a Car Wheel Mannfacturer (since 1847) and member of firm of A. Whitney & Sons.

The process practised by us

"Is, and always has been that described in the Patent granted to my father, Asa Whitney, April 25, 1848."

The material used has been pig iron possessing chilling properties.

The mould in which metal is poured is composed of sand, except that portion which forms the tread, or rim, which is of iron, and this gives to the melted metal what is called its "chill;" the "chill" extends ½ to ¾ of an inch in depth.

Prior to 1847 had a general knowledge of the different modes and patterns then in use for making cast iron car wheels. Most common way was from a spoke pattern with divided hub to admit of contraction caused by cooling.

Various plate patterns were also in use, the plates being curved more or less.

"After being cast, all these wheels, so far as my knowledge extends, were allowed to cool in the sand and chill in which they were cast.

"Up to 1847, no cast iron car wheels had been produced which satisfied the growing demands of the railroad service; all were more or less defective, inasmuch as when properly chilled, they were deficient in strength, and liable to break in service from the inherent strain left by the manner of their cooling."

Distinction between cast iron car wheels and ordinary castings extends back to 1835, in my recollection.

The prior defects were entirely overcome by process patented to Complainant. * * * There was a general confidence felt in regard to the strength of his wheels and their durability which never had been the case regarding other wheels.

Have read Mowry's Patent and Knight's deposition, and think process of Defendant is identical in operation and result with Plaintiff's.

"Both taking red hot wheels before they are injured by contraction in cooling, putting them in a furnace, chamber, or pit; then raising the temperature of the wheels to a uniform degree throughout, and then permitting them to cool so slowly that, when cold, no strain is left upon them by unequal shrinking."

Mowry's process same as Whitney's.

If different parts of a wheel were raised in temperature unequally, strain would be produced.

Gives narrative relative to suit against George H. Thacher, of Albany, and of the compromise of same.

Has no interest in Complainant's Patent.

Cross-Examination.

First saw a car wheel cast with a chilled rim in 1835, at Albany.

Asa Whitney's Testimony.

Age 74; resident of Philadelphia; Machinist. Have been engaged in manufacture of car wheels since 1847. Since then our firm has made

Printed pp. 6-875. Rec.

464,475 wheels according to process patented to me April 25, 1848. Commenced making wheels in 1847; very few in that year; they were mostly experiments.

Considered as my invention

"Annealing or prolongation of the cooling of car wheels, so as to prevent any inherent strain in the wheel when cool."

Prepared statement as to the progress of art of manufacturing car wheels, which was filed with my application for extension.

Gives version of suit against Geo. H. Thacher, and compromise of same.

Cross-Examination.

Printed Rec., pp. 71–75.

What Whitney says about annealing processes prior to his Patent.

"All persons familiar with iron foundry knew at that time (date of witness' invention) that there was difficulty in getting strong castings from patterns of unequal thickness. I knew of no mode of overcoming the difficulty at that time, except the common one resorted to, of taking the sand from the thick part of the casting and exposing it to the atmosphere, the thin parts retaining the heat imparted to the sand about them, so that the cooling was so nearly equalized as to enable founders to make castings of considerable inequality in thickness."

* * * * * * * * *

"I knew of no other general means to equalize the cooling, other than that mentioned in my last answer. But in special cases the form of the pattern might be such as to make it necessary to expend fuel on the casting after it was taken from the sand. This was done.

This principle was well known, that is, that all metals are larger when hot than when cold, and when one part, by reason of its being thinner, loses its temperature sooner than the other, there will be inherent strain," &c.

+ Q. 7. Up to the time of your application for your Patent, had you any knowledge of car wheels being annealed, or the time of cooling being prolonged by any mode?

A. I had not.

* * * * * * * * *

"I do not now know that any mode was practised prior to that date (1847). I have been told quite recently that wheels prior to that time were taken from the mould and covered up in dry sand to prolong the cooling. I have heard of that only in one instance."

The remainder of the deposition of this witness, from +Q. 9 to end, bears on the question of infringement, the Counsel asking if there are not differences specified in his questions between Complainant's and Defendant's processes, and the witness answering in the negative.

—John H. Redfield—Henry

Complainant's Exhib

15

COMPLAINANT'S EXH Whitney, *v.* Thacher.

Rec., p. 106.

Whitney's "History of the Art," filed w
sion.

* * * * * *

"The rails, and the wheels on which the matter
upon each other at the point of contact between v
ence, however—in the aggregate each unit of th
contact with that of the rail as many times oftene
ceeds that of the circumference of the former, thu
responding increased wear. The first wheels used
at the mines, where both rails and wheels were m
wood to iron was simultaneous for both rails and v
of cast iron; these first cast iron wheels were ma
iron, *in sand moulds; they did but little service; the*
other part, a groove was soon worn into the same by
that besides being soon destroyed itself, the wheel t
spalling off the edges. The next step of improveme
of cast iron, having the surface of the tread hard,
as to secure both strength and hardness, where eac
accomplish this, that part of the mould in which t
of iron, and all the other parts of sand. Iron bei
heat than sand, when the molten iron was poured
as came in contact with the iron part of the mou
more rapidly than that which came in contact wit
This iron part of the mould is called the *chill.* In
and change from the liquid to the solid state, was proc
the surface of the tread thus formed being nearly
steel. It was all that could have been desired, so
cerned. But another difficulty presented itself, indu
the tread; the wheels had no strength, would gene
strain on them before they became cold, which inh
follows:"

* * * *

The tread or rim was connected with a s
or spokes; the molten iron was poured into th
it flowed out, &c.

* * * *

To remove this difficulty, the next step w
sections, instead of casting it solid, &c.

* * * *

"Railroad wheels made entirely of cast iron, subst
described, having their hubs divided into sections,
in the United States at the commencement of our r
that description continued to be almost the only kin

, No. 2212, Nov. 19, 1833.
ham, No. 611, Feb. 15, 1838.
ush & Lobdell. No. 637,
7, 1838.
Wolf & Dougherty, No. 640,
7, 1838.
y, No 4330. Dec. 26, 1845.
Lizer, No. 5076, April 17,

, No. 32,252, May 7, 1861.

aling oven, patented and

furnace for same purpose."
itney's, as described in his

stimony.

Cashier and Inspector A.

Printed Rec., pp. 84-85

wheel by cold chisel for
dom from strain by blows

Inspector for Whitney & Sons.

wheels, and as the result
red; not 2 in 1000; and

Very uncommon to find the "chill" injured

anting in strength.
per management or care-
ade under Asa Whitney's

mony.

lder and foreman of foun-

Printed Rec., pp. 85-87.

as 14 years of age; been
ith Mr. Whitney early in

Foreman for Whitney and Sons.

At about that date, our roads began to be made more substantial and unyielding, and higher velocities of movement upon them began to be demanded. Under these circumstances, the cast spoke wheel began to show its defects more prominently than before. Among the objections to them, was the expense of filling the spaces between the sections. * * * To avoid these difficulties, other means were employed to compensate for the unequal cooling and shrinking of the parts, than that of dividing the hub into sections, and otherwise to make the cast wheel more secure against breaking. These efforts began to be made early in our railroad history; they were all, or nearly all, confined to the idea of making the hub solid, and connecting the hub and rim by a disc or plate, which were generally made double, two plates extending from hub to rim, in form concave or convex, so as to be susceptible, as was supposed, of contracting or expanding in diameter as much as would be required by the unequal cooling and contraction before noticed. These wheels, when skillfully made, were an improvement on the spoke wheel, with the hub divided into sections, so far as safety was concerned, but they were still faulty as to cost and durability."

* * * * * * * * *

"The next effort was to prevent this inherent strain, not by the form of pattern from which the wheels were cast, but by subjecting them to a process after being cast, with a view of controlling their loss of heat, so that all parts of the wheel should cool and shrink simultaneously.

This process consists in taking the wheel from the mould in which it has been cast, as soon as it has become sufficiently cool to be strong enough to bear moving without changing its figure, and before it has become so much cooled as to produce any considerable inherent strain between its parts, and in this state putting it into a furnace or chamber that has been previously heated to a temperature as high, or nearly as high, as that of the wheel when taken from the mould. In this way, each successive wheel, in the order in which it has been cast, is passed into a furnace or chamber of this kind, the opening through which they are passed being closed during the interval between their being thus placed, and as soon as the whole number designed to be deposited in one of these chambers has been put in, the opening is more permanently and perfectly closed, so as to prevent the escape of heat through that aperture. The temperature of this furnace or chamber, and its contents, is then gradually raised to a point *sufficiently below that at which fusion begins, to avoid disturbing the previous crystallization of the wheel*, all the avenues to and from the interior of this furnace are then closed, combustion ceases, and the whole mass is left to cool no faster than the heat it contains permeates through and radiates from the exterior surface of the furnace. The wheels subjected to this process remain in these heated chambers three or four days after they are cast, and when taken out, their temperature is somewhat above 212 degrees Fahrenheit."

* * * * * * *

"I claim to be the inventor of this process, for which *Letters Patent* were granted to me for the United States, April 25, 1848.

"It was predicted at the outset, that to subject wheels to this process would deprive them of that peculiar hardness imparted to them through the agency of the chill, but that prediction has been proved incorrect by experience in use of the wheels thus made." * * *

(Signed) A. WHITNEY.

Exhibit "G." Declaration, &c., in suit of Whitney, *v.* Thacher. Rec., p. 106.
" "H." Copy Patent to John Elgar, No. 2212, Nov. 19, 1833.
" "I." " " " R. H. Dunham, No. 611, Feb. 15, 1838.
" "J." " " " Boney, Bush & Lobdell. No. 637, March 17, 1838.
" "K." " " " Truscott, Wolf & Dougherty, No. 640, March 17, 1838.
" "L." " " "Geo. W. Eddy, No 4330, Dec. 26, 1845.
" "M." " " " G. W. & H. Lizer, No. 5076, April 17, 1847.
" "N." " " "A. L. Mowry, No. 32,252, May 7, 1861.

THOS. W. MASON, (Model Maker.)

Proves models as follows:

Exhibit "O O," Model Mowry's annealing oven, patented and flanged tube.
" "P." " for an annealing furnace for same purpose." representing Whitney's, as described in his Patent.
" "P'." " represents stack.

John H. Redfield's Testimony.

Age fifty-one; residence Philadelphia; Cashier and Inspector A. Whitney & Sons. Printed Rec., pp. 84-85

Inspection means we test the tread of the wheel by cold chisel for hardness, and the plate for toughness and freedom from strain by blows on the plate. Inspector for Whitney & Sons.

Have inspected at said Works about 80,000 wheels, and as the result say it is very uncommon to find the chill injured; not 2 in 1000; and more rare to find any of the plates that are wanting in strength. Very uncommon to find the "chill" injured.

Attribute such defects when found to improper management or carelessness of the workmen in charge of the fires.

The wheels I have inspected have been made under Asa Whitney's process, patented April 25, 1848.

Henry Snyder's Testimony.

Age 51; residence Philadelphia; Iron Moulder and foreman of foundry of A. Whitney & Sons. Printed Rec., pp. 85-87.

Been engaged in iron founding since I was 14 years of age; been among car wheels for 30 years; commenced with Mr. Whitney early in May, 1847, and have been with him ever since. Foreman for Whitney and Sons.

Whitney's process of manufacturing car wheels does not affect the "chill" at all.

The effect, as to the unchilled parts, is to take the strain off.

"Sometimes we run a month and do not disturb a chill. Then again if we fire up a little too strong we may burn a wheel or two.

"When this happens it is an accident, and it is attributable to the fireman not paying attention."

Exhibit "Q."

This (Ex. "Q") is the model of a cut-hub car wheel.

I made such about thirty years ago in Baltimore; don't know of any such being made now.

Exhibit "R."

Ex. "R" represents a double-plate wheel with a divided hub.

Exhibit "S."

Ex. "S" represents A. Whitney & Sons' Works.

Cross-Examination.

Whitney at first made a corrugated plate wheel, now makes a straight plate wheel.

Mr. Whitney at first made a corrugated plate wheel; those now made have straight plate with brackets on the back.

"+Q. 3. You will now please describe particularly that process (that practised by Whitney).

Process as *practised* at Whitney's Works.

"A. The wheel is moulded in sand, except the tread, which is moulded in a 'chill,' the 'chill' forming the tread of the wheel. After the wheel is cast, we take it out of the chill while it is red, and put it into the furnaces that are heated up; we fill the furnaces full of wheels and then shut them up; then we let the fire operate in those furnaces to equalize the heat of the wheels; then we shut the draft off.

Don't heat the wheels to a point, "*say a little below that at which fusion commences.*"

"We leave them in until the fourth day, and that completes the process.

"+Q. 4. State whether these wheels in the annealing pit or furnace are heated to a point 'say a little below that at which fusion commences.'

"A. I don't think we heat them up as high as that; we only keep them at a red heat.

"If you heat to *near* fusion you draw the chill out: we don't want to heat them any hotter than a *cherry red.*"

"+Q. 5. What is the result of your observation as to the effect upon the 'chill' where they are heated to a point at all approaching, or anywhere near, that at which fusion commences?

"A. If that question is as to the effect, if you heat them up to a soft state you draw the chill out: if you heat a wheel to near fusion you draw the chill out. We don't want to heat them any hotter than a cherry red.

Fusing point of iron, 2786° F. "Cherry-red" heat, 1500 to 1600° F.

"+Q. 6. State how much better, if any, they are made than when taken from the moulds.

"A. We let the heat operate in there to equalize the heat of the wheel to take the strain off.

"A. We make them hotter; that is, the rim and plate, but I cannot say how much; I mean, I can't tell in degrees We have to determine this by practice.

"+Q. 7. Do you reheat them now more or less than you did when you first commenced to use Mr. Whitney's process?

"A. We don't heat them any more; we only heat them enough to take the strain off; about the same as we did at first—no more and no less."

* * * * * * "If the fire is strong we can put the wheels in in two hours after first lighting up the fire in the furnace.

"In 1847 we had the fire right in the annealing oven where the wheels were set; now the fire is outside the annealing oven altogether, and the flame worked into the annealing oven through a flue.

"Have been no other changes as regards annealing them."

ELGAR'S PATENT—Nov. 19, 1833.

Describes improvement in wheels by which they will be better adapted to running on curved roads, the improvement consisting in making the outer part of the "tread" (the tread is that part which runs on the rail) conical; also the substitution of wrought iron plates for spokes usually employed.

Exhibit "H." Rec., p. 88.

DUNHAM'S PATENT—Feb. 15, 1838.

Casts wheels in an *iron* mould. * * *

"But instead of continuing the arms of the wheel to the rim, as is now the case, and partly *annealing* that section of the rim to which it extends, I make two rims, the space between them being two inches," &c. * * * * *

Exhibit "I." Rec., p. 89.

***Claims*—Making of two rims connected at the sides. * * * ***

"In other words, constituting a hollow felloe, cast in one hollow connected mass entirely around said wheel, and the whole wheel, it may further be remarked, is cast in an entire casting."

BUSH & LOBDELL'S PATENT—March 17, 1838.

Describes a wheel with the hub divided into two parts transversely, between two face plates, each convex outwardly.

Exhibit "J." Rec., p. 90.

TRUSCOTT, WOLF & DOUGHERTY'S PATENT—March 17, 1838.

Claim—"The manner of constructing wheels for railroad cars, or for other purposes to which they may be applied, with double convex plates, one convex outwards and the other inwards, and an undivided hub, the whole cast in one piece.

Exhibit "K." Rec., p. 91.

Exhibit "L."

EDDY'S PATENT—December 26, 1845.

Claim—"I do not claim the manner of constructing a cast iron or metal railway car wheel by making it of two convex or concave plates, or one convex and one concave plate united to a solid or a divided hub and a circular rim and flanch, as heretofore made; but that *which I do claim is my improved manner of constructing a wheel, by which I am enabled to cast it with a solid hub, and in other respects as I have above set forth*, viz.: by making it with an *undulating* plate, in combination with a concave or convex plate or another undulating plate, as herein described."

Exhibit "M."

SIZER'S PATENT—April 17, 1847.

Claim—"What we claim as our invention, and desire to secure by Letters Patent, is the casting a car wheel of two plates of metal, of the form herein set forth, united to the rim and hub, the respective plates being concave outwards, curving from hub to rim, the object of which form is to cause the plates to contract uniformly, and to enlarge the space between the same at the weakest point, as the metal cools, after casting, thereby enabling us to allow the core to remain in the wheel till it becomes perfectly cold. *The core remaining in the wheel causes the same to cool slowly, having the effect to anneal and toughen the metal, as is well known to metallurgists.*"

Edward S. Renwick's Testimony.

Printed Rec., pp. 94–119.

Age 43; residence New York City; occupation, Solicitor of Patents and Expert.

Have read Complainant's Patent, No. 5531 Find therein improved process described of manufacturing cast iron railroad car wheels: specifies wheels cast in the ordinary manner as of that time, which consisted in pouring the metal into a mould composed in part of cast iron and in part of sand; result was tread of wheel was rapidly cooled, while rest of wheel being in contact with sand cooled more slowly.

Whitney's Patent.

This difference in speed of cooling caused unequal contraction and inherent strains.

Object—Whitney's invention was to neutralize strains which occurred in the mould, and then operate on it so that the various parts would be compelled to cool simultaneously, so no new strains would be caused; *and to do this so as not to disturb "the relative conditions of the metal in the different parts of the wheel (namely, the highly crystalline and hard condition of the metal at the rim, the "chill," and the granular and tough condition of the metal in the plate or spokes and hub.)*

Its object.

Then refers to means for accomplishing this purpose as described in the Patent, &c.

Has read Mowry's Patent and Knight's deposition.

Ans. to Ques. 7.

Thinks Mowry's process substantially the same as Whitney's; gives reasons in full.

Is asked to examine agreed copies of references to public works, as contained in Defendant's answer, and to state whether finds, in either of same, description of improvement, as set forth in Whitney's Patent. Said copies are (briefly) from the Encyclopedia Brittanica, seventh edition, 1842, vol. 3, pp. 196, 197; vol. 10, pp. 562 to 579; vol. 12, p. 435. Ure's Dictionary, second edition, 1842, p. 339, p. 582, p. 584, pp. 1177 to 1182. Pilkington's Repository, 1840, pp. 281 and 282. Holtzappffel, 1843, notes on pages 371 and 372, and note F, on p. 462. Lardner's Encyclopedia, vol. 1, 1831, pp. 70, 73, 74, 75, of chapter IV.; pp. 300, 301, chapter XIX., and p. 326 of chapter XX. Franklin Institute Journal, vol. 13, New Series, 1834, pp. 150 to 154, and pp. 218, 219; same work, vol. 1, 1826, pp. 224, 225, 226; same work, vol. 4, 1827, p. 45. Cresy's Encyclopedia, vol. 1, 1847, p. 689, extract from Rees' Encyclopedia, as specified in said answer. Mushat on Iron and Steel, 1840, p. 517. Philosophical Transactions, 1840, pp. 503 to 527. Engineer and Machinists' Assistant, 1847, pp. 161, 169. Brande's Dictionary, 1843, p. 54. Prince's Record of Patent Inventions, 1843, p. 139. Cutbush, 1814 (Artist's Manual), Article "Annealing," Gregory, vol. 1, 1815. Article "Annealing," Jamieson, 1827, p. 45. Webster's Dictionary, 1828. Article "Anneal," Directory, &c., by A. and C. R. Aiken, 1807, vol. 1, pp. 74, 347, 348 and 349. Hebert, vol. 1, 1837, p. 94. Dobson, 1808, vol. 7, p. 783. London Encyclopedia, 1845, pp. 341 and 342; vol. 10, pp. 222 to 237; vol. 20, pp. 757, 758, 759; vol. 21, pp. 721, 722, 723, and pp. 189 to 193. Tredgold, 1842, sect. 1, Introduction, pp. 8 to 11.

"Q. 9. Do you find in any one of said extracts a description of the improvement set forth in the Complainant's aforesaid Letters Patent, No. 5531, and dated April 25th, 1848?

"A. I do not find in any one of said extracts a description of the improvement set forth in Complainant's said Letters Patent. No one of said extracts describes any improvement in the process of manufacturing cast iron railroad wheels. No one of them describes an annealing process by which the articles operated upon are left with the materials of which they are composed in the same two conditions that the material of cast iron car wheels is left in after being subjected to Complainant's process; that is to say, with one portion of the material crystalline and brittle, and another portion thereof granular, soft and tough; and no one describes an annealing process which, if effected, without change, upon cast iron railroad wheels, would produce the result of the Complainant's process."

Mr. Renwick proceeds to consider each of the references cited, and to give his reasons for the conclusion stated in his answer last quoted. His deposition is of unusual length, and it is believed that by inserting

here copies, or abstracts thereof, of a few of the "references," and then quoting what the witness testifies relative thereto, a fair and full understanding of his testimony will be arrived at.

Encyclopedia Britannica, Vol. 3.

"Annealing, by the workmen called 'nealing,' is a process used in glass making and in the manufacture of certain metals.

"In glass making it consists in placing the bottles, &c., whilst hot, in a kind of oven, or furnace, where they are suffered to cool gradually.

"They would otherwise be too brittle for use." * * *

* * * * * * * * *

"By the process of annealing the glass is kept for some time in a state approaching to fluidity; the heat increases the bulk of the crystallized part, and renders it so soft that the internal parts have the opportunity of expanding and forming a regular crystallization."

* * * * * * * * *

London Cyclopedia.

"*Annealing*—Annealing of glass, by the workman called nealing, consists in placing the bottles, &c. whilst hot, in a kind of oven or furnace, where they are suffered to cool gradually," &c. * * * *

* * * * * * *

"By the process of annealing the glass is kept for some time in a state approaching fluidity."

* * * * "A similar process is used for rendering kettles and other vessels of cast iron less brittle."

* * * * * * *

"The cast metal should be taken out from the sand of the flasks as soon as it has become solid, and while it is yet red hot, and the face must be kept downwards to prevent it from sinking; holding it by the git, force out the sand from the middle of the mirror with a piece of wood or iron, and place the speculum in an iron pot with a large quantity of hot ashes or small coals, so as to bury the speculum in them a sufficient depth.

"Let the speculum remain in the ashes till the whole is become quite cold."

American Artist's Manual, Published by Cutbush, Philadelphia, 1814.

"*Annealing*—When a substance melted, or nearly in a state of fusion, is cooled very hastily, its texture is so much altered, that, if a ductile metal, it loses much of its malleability, and cannot be extended far under the hammer without cracking; or, if a brittle metal, a glass or vitrescent mixture, it is liable to fly to pieces by a very slight change of temperature or external injury. To avoid this, the process of annealing is resorted to, which is nothing more than cooling the heated or melted substance as slowly and equally as possible—often in a seperate furnace of the requisite heat, and sometimes called an *annealing oven*. The utility of annealing is shown very conspicuously in the manufacture of *Glass*, the castting of *Speculum Metal*, or the beating of *Gold*.

"The difference between unannealed and annealed glass is very remarkable."

* * * * * * *

"By the process of annealing, the glass is preserved for some time in a state approaching to fluidity; the heat increases the bulk of the crystallized part, and renders it so soft that the internal fibres have an opportunity of expanding and forming a regular crystallization.

"A similar process is now used for rendering kettles and other vessels of cast iron less brittle, which admits of the same explanation as that above stated. The greater number of metals diminish in bulk when they pass from a fluid to a solid state. Iron, on the contrary, expands."

What Mr. Renwick says:

"In the extract from the Encyclopedia Brittanica, vol. 3, several processes of annealing are described: the first is the annealing of glass, and consists in placing the articles while hot in an oven or furnace, where they are suffered to cool gradually, the result of which operation is, that all parts of the article are left in the same condition. This process differs substantially from the process described in the Complainant's Patent in the following respects: It is not an improvement in the art of manufacturing cast iron railroad wheels, nor does it suggest any such improvement; on the contrary, by describing in substance that the article is left with the material of which it is composed in the same condition of regular crystallization throughout, it suggests a result which is the reverse of what is required in cast iron railroad wheels, and in my opinion, a person who should, prior to the date of the Complainant's invention, read such portions of the said extract that relates to the annealing of glass, would be led to think that cast iron railroad wheels could not be treated by the same process, because the result to be attained in them is substantially different from the result that is attained by the annealing of glass in the manner described. Again, the said extract describes that the glass articles are simply suffered to cool gradually, and does not describe or suggest that, previous to such cooling, they are to be heated to a higher temperature than that at which they enter the annealing furnace, so that the said extract is substantially different in this respect from the process described in Complainant's Patent."

* * * * * * *

"The portion of the extract which describes the manufacture of a speculum states that the speculum while hot is to be placed in an iron pot with a quantity of hot ashes or small coals, for the purpose of annealing it. There is no statement in this portion of the extract, that the heat is to be raised after the speculum is placed in the pot; the extract, therefore, does not describe or suggest the first essential operation of the Complainant's process; besides, as a pot is a vessel which has no apertures at its sides or bottom to admit air, the coals, if small coals were used, would not be subjected to a draught, which would raise the temperature of the speculum when placed in them as described, and the result would be that the speculum would simply cool down more gradually than it would if left in the sand mould, &c.

"Speculum metal is perhaps the most intractable of any of the alloys, and it serves to illustrate, in a remarkable manner, the many effects that occur in casting generally. Small speculums are cast in sand; as soon as they are set the sand core is pushed out of the aperture in such as are intended for Gregorian telescopes, to enable them to contract without fracture, *and the red hot disc is surrounded by ignited wood ashes, or any very bad conductor, to delay the cooling.* These precautions entirely fail with large speculums, as the margins solidify the first, and from the

Holtzapffel's Mechanical manipulation, &c., London, 1843.

absence of ductility, the central parts tear away in the act of contraction, and the mass becomes rent or flawed."

* * * * * * *

"The plan ultimately adopted by Lord Oxmantown was the porous hoop-iron mould, with a marginal ring of sand; the mould was heated to about 212 degrees Fahrenheit; it was filled very quickly, and the moment the metal was solidified, it was drawn into an annealing oven previously heated to about the same temperature as the casting, so that for small reflectors of nine inches diameter, the cooling might be extended over about three days, and for large ones of thirty-six inches diameter, over about fourteen days; with these precautions the process was uniformly successful. (See Trans-Royal Soc., 1840, pp. 510–11.) The whole of the paper 'On the Reflecting Telescope,' pages 503 to 527, is quite a study for those interested in the construction of telescopes, and possesses nearly the same interest for the general mechanist."

What Mr. Renwick says:

The extract from Mr. Holtzapffel's Turning and Mechanical Manipulation, describes the manufacture of specula for telescopes. The processes described in this extract are, in my opinion, substantially different from the process described in the Complainant's Patent, for the following reasons: They do not describe or suggest the manufacture of cast iron railroad wheels, or any improvement in that art; they describe the manufacture of an article, the material of which is in a highly crystalline condition throughout its whole mass, thus differing from a cast iron railroad wheel, in which one portion of the material is crystalline, hard and brittle, while the remainder is comparatively granular, soft and tough. The extract describes that a speculum may be permitted to contract without fracture, by placing it, while red hot, in ignited wood ashes, or any very bad conductor, to delay the cooling, and also that the same effect was obtained with the six foot speculum of the Earl of Ross, by dragging it into an annealing oven, and extending the annealing over a period of two months. No portion of this extract describes or suggests the heating of the speculum to a higher temperature than it had when taken from the mould (for the purpose of retrieving the effect of strains incurred in cooling down to the temperature at which the speculum is taken from the mould), previous to permitting it to cool gradually; the extract, therefore, does not describe or suggest one of the essential operations of the Complainant's process. The processes described in the extract are in substance substantially the same as the process of annealing glass by permitting it to cool gradually, and are not applicable to the manufacture of cast iron rail road wheels.

Cross-Examination of Renwick.

Q. 14. The next step in the process of the Complainant, as described in his Letters Patent, after the wheels are deposited in the furnace and the opening through which they have been passed is closed, is raising the temperature of the furnace and the wheels gradually to a point a little below that at which fusion commences, is it not? Rec., pp. 109–115

A. The mode of practising the process described by the Complainant, is to raise the temperature of the furnace and wheels as stated in the question, but I do not understand that the specification restricts the temperature to which the wheels are raised to a point a little below fusion, but that that temperature is one at which the effect which he desires to obtain by the increase of temperature will be attained; the temperature must be such, as stated in another part of the Patent, that all parts of the wheel may be raised to the same point.

Q. 15. What, as a scientific man, do you understand by the words in the Patent, "say a little below that at which the fusion commences?"

A. I understand a temperature a little below that at which the materials of the wheels would begin to melt; the expression conveys to my mind the idea that it is the highest temperature to which the wheels might be raised without risk of melting them, or a heat below that at which the wheels would become distorted by the iron changing its shape by a loss of its cohesive power.

Q. 16. When the plates of the wheel approximated the point of usion, would the hubs and treads of the wheel be at a higher or a lower temperature than the plates?

A. The thinner parts of the wheel would be at a higher temperature than the hubs, which are the thicker parts, or at the same temperature, according to the mode in which the heat was applied. The thicker portions of a casting absorb heat more slowly than the thinner parts; consequently, if the heat were applied more rapidly than the thick portions took it up, the thinner portions would approximate to the point of fusion more rapidly than the hub, but if the heat were applied gradually, so that the heating of the thicker portion kept pace with the heating of the thinner portions, there would be no material difference in the heat of the parts of the wheel at the time the highest temperature was reached.

Q. 17. If the heat in Whitney's process was introduced at the instant of introducing the wheels into the furnace, would the temperature of the hubs and treads of the wheels be greater or less than the temper-

ature of the plates, when the temperature of the latter was a little below that at which fusion would commence?

A. 18. The temperature of the different parts of the wheel would be substantially the same when the plates arrived at a point a little below that at which fusion would commence, because the heat in the Whitney process would be raised gradually.

* * * * * * *

Q. 19. Would not, in any furnace, whatever its form, into which the wheels might be placed, if the same degree of heat came in contact in the same manner with all parts of the wheels, necessitate the heating of the thinner parts of the wheel more rapidly than the thicker parts?

A. I suppose, theoretically, the thinner parts should heat faster than the thick parts, but, practically, I don't believe there could be any material difference, unless the heat were increased too rapidly.

Q. 20. This being as you have stated, would not the application of fuel directly to the plates of a wheel, and not to its other parts, cause the heat of the plates to be increased more rapidly than that of the thicker parts in a *practical sense*, the operation being supposed to be conducted in a furnace such as described by Mr. Whitney, or in any furnace where air was admitted to support combustion?

A. If the operation were performed in a furnace, such as described by Mr. Whitney in his Patent, with coal burnt upon the grate, and in addition with fuel placed in contact with the plates of the wheels, which I understand to be the hypothesis in the first part of the question, I don't believe that the heat of the plates would, in a practical sense, be increased more rapidly than the heat of the thicker parts, unless the fuel, so placed in contact with the plates, was charcoal, and the fire upon the grate was permitted to die out as the wheels were introduced, in which case the presumption would be that the current of air entering through the grate, and passing around the exterior of the wheels, would keep the rims from raising in temperature as rapidly as the plates which were in immediate contact with the burning charcoal. The latter part of the question is too indefinite for me to answer, as the character of the furnace would affect the result, and therefore I should know the character before answering.

Q. 21. Do you give this opinion positively, or as a matter of impression?

A. I give it as the result of reasoning upon the subject. I have never made the experiment, and therefore cannot state what would be the positive result.

Q. 23. What, in your opinion, would be the effect upon the chill of the wheel if all parts of it were raised to a temperature, say a little below that at which fusion commences?

Effect upon the "chill" of high heat.

A. If the temperature after being so raised was then lowered, I do not think there would be such a change in the chill as to affect its value for practical use; but if the temperature were maintained at that point for a considerable space of time, the hardness produced by chilling might be materially affected; and *I have no doubt it would be materially affected if, at the same time, air containing free oxygen were permitted to act upon it, as chilled iron, under such circumstances, changes its character by the burning out of the carbon contained in it.*

* * * * * * *

Jamieson's Dictionary.

Q. 26. In the article referred to, in the same connection, occur the following words: "by the process of annealing the glass is kept for some time in a state approaching to fluidity." Do you infer from that that heat is applied to the annealing furnace, and that the temperature of the articles introduced into it is raised subsequent to their introduction?

A. I do not. I infer that the temperature of the annealing furnace is at its highest point when the articles are introduced into it, and that neither its temperature, nor that of the articles, is raised after such introduction, and that the temperature is maintained for some time at the same point.

Q. 28. Is your opinion, as expressed in your examination-in-chief that this process as applied to glass is substantially unlike Whitney's process as applied to car wheels, predicated upon the interpretation which you have given to the extract last referred to, in whole or in part?

A. That is one of the reasons for the opinion that I expressed.

With the consent of Defendant's Counsel, the following questions are asked as a re-direct examination of the witness:

1. Considering the improvement set forth in the Complainant's process, simply as a process of annealing, and irrespective of the peculiar character or mode of forming the article operated upon, is there any, and if yea, what difference between it and the processes of annealing described in the extracts from public works to which you have been referred in your examination-in-chief?

A. There is a substantial difference between it, so considered, and he processes referred to in the question. All those processes consid-

ered simply as annealing processes may be divided into two classes; which are, *first*, those in which the article, *while hot*, is *permitted to cool very gradually*, instead of cooling comparatively rapidly, as it naturally would, if exposed to the air during such cooling; secondly, those in which the article is first permitted to become cold in the natural way, and is subsequently heated to a low red heat, and then permitted to cool very gradually. Of the *first class*, the *annealing of glass* and of the *speculum*, described in the Philosophical Transactions as made by Lord Oxmantown; of the second class, the annealing of iron and steel wire as described in the Franklin Journal, vol. iv., pp. 45 and 46, is an example. The process described in the Complainant's Patent, considered as supposed in the question, differs substantially from the first class, in the respect that the article, although taken hot from the mould, is heated to a higher temperature than it is when so taken, before being permitted to cool gradually. It differs substantially from the second class, in the respect that the article is not permitted to become cold before it is reheated. *Both of these differences are irrespective of the degree of heat required for performing the Complainant's process, which is much higher than that required for performing the processes described in the extract.* The *result* of the process is also substantially different from those described in the extract, *being to preserve the distinctive characteristics of the hard and soft portions* of the article operated upon; while the result of all the other processes is to reduce the material of the article to a uniform condition throughout.

Q. 2. Please read in the deposition of George G. Lobdell, taken in this case, an agreed true copy of which is now shown you, the answer of said Lobdell to question three, and state whether or not, in your opinion, the process of annealing therein described by him embodies the improvement described in the Complainant's Patent, and give your reasons for the conclusion you may express.

The answer of Lobdell referred to is as follows, to wit:

"I have known, prior to 1847, small pulleys to be placed in iron vessels or any old pot, with charcoal and iron trimmings packed around them, and this old pot placed under the cupola, the contents of the cupola hauled out, covering the pot, both for the purpose of making them soft, so that they could be turned easily, and for the purpose of preventing the arms from fracture.

"The cause of the fracture of the arm of a pulley was because one part remained hot longer than the other, consequently the hub being the heaviest part of the pulley and the last to cool, would produce a strain on the arm when it cooled or contracted: this process caused all parts of the pulley to cool alike."

A. In my opinion, the process described in the answer referred to in

the question, is substantially different from that de eal. The castings
plainant's Patent; the operation of the process desc
is that all parts of the pulley should be caused to c This was not an- by the parts of the
distinction to cooling with different speeds by one hat the character of
longer than the other. The description in the said nd shielding other
definite; so that it is not certain, from the descript times pouring water
ticle to be operated upon was taken hot from the ient. The object of
think the presumption is, that the witness intende
that it was taken hot from the mould. If this be * * n the dump of the
heating up or raising the temperature of the oven i m to cool gradually
or described; nor are any means described by whic The dump of the
regulated, as the only description is that the conten d to the wheels was
hauled out (of the cupola), covering the pot, and it * * nient, as they could
chance whether these contents were large or sma oals from the cupola
the size of the article. No means also are descri e ground in front of
regulating the cooling so that all parts of the arti until morning."
shrink simultaneously, it being a mere matter of * *
mass of material hauled from the cupola should co
or shorter period of time. The object and effect of t ards in diameter.
in the said answer are also substantially different s a trial, and not
effect of the Complainant's process, in the respect th
of the former was to make the articles soft, so that t e processes were
easily, and as pulleys are always turned upon the
effect was to make the rim soft, whereas the obje
Complainant's process is to leave the rim hard. T
not describe or suggest any improvement in the man ls" not then gen-
railroad wheels, or any means by which such manuf
tised; in fact, by stating that one of the results of
render the articles soft, it suggests that the process lifficulties not en-
applied to the manufacture of cast iron railroad whe
tion corresponding to the part of a pulley which is
must be left hard. The process also does not sug *my.* Rec., pp. 121–127.
manufacture of any article by casting it in a moul nufacturer of Car
of iron and in part of sand.

Q. 3. Please read in the deposition of Paul A. ves his version of
this case, an agreed true copy of which is now sho
to questions 6 and 7, and give your opinion, suit was brought,
therefor, as to whether or not the mode of treatme the charcoal was
embodies the improvement set forth in the Complai ed to the *rims*,

A. The process described in said answers, as I opening or air
substantially the same as that described in the ect was

Annealing processes as practised by Sabbaton prior to 1840.

"To carbonize the rim or 'chill,' but found the carbonizing effect scarcely perceptible; at end of three days the charcoal was not more than one-third consumed."

* * * * * * * * *

Since 1858

"Have placed the wheels in the same position relatively to each other as before described, and simply covered with sand, using no fuel of any kind; that is the process I am using to-day.

"I have found the sand process to be the best and cheapest."

* * * * * * * * *

Whitney's process would utterly ruin the "chill."

"I understand it (Whitney's process). If the process as described and claimed by him was strictly followed I believe it would utterly ruin the chill of the wheel, and materially diminish its strength. I do not believe that Mr. Whitney has ever conformed to his own process, as claimed."

Cross-Examination.

+Q. 1. At what stage of Whitney's process, as claimed by him, the same being strictly followed, would the chill of the wheel be utterly ruined, and its strength materially diminished?

Wheel cannot be moved from the mould until it has cooled hundreds of degrees below the point of fusion.

A. When, after its being removed from the mould, and placed in his heated oven, its temperature is raised to a point a little below the point of fusion. It cannot be moved from the mould till it has cooled hundreds of degrees below the point of fusion, and the re-raising of the temperature to near the point of fusion would re-disturb the particles of the iron and the texture of the "chill."

+Q. 9. Do you understand Mr. Whitney's claim to involve, as a necessary stage in his process, the raising of the temperature to a point a little below fusion?

A. If he carries out the entire process as described in the claim, I do so understand it.

"I think he uses, and must use, in order to make a good wheel, only a part of his process; that, in proportion as he raises the temperature above what existed in the wheel at the time of placing it in the pit or oven, in that proportion he injures the texture of the wheel. I believe that the sooner the wheel can be cooled consistently with an equalization of its tension, the better it will be in every respect."

Does not think absolute equality in temperature between thick and thin parts of the wheel can be realized—can only be approximated.

George S. Bosworth's Deposition.

Printed Rec., pp. 127-130.

Age 56; residence Troy; Foreman Car Wheel Works 14 years; worked at iron castings 41 years.

Prior to 1847, know of no other process of annealing iron castings than that of putting charcoal around certain parts that would cool the quickest, so that all would shrink alike. These were mill gearing, spur wheels and fly wheels.

Being asked as to effect of re-heating car wheels to a point, "say a little below that at which fusion commences," says:

"I think, sir, it would have a tendency to draw the chill." * * * "The effect would be to soften the chill; that is what I think it would do." Effect of heat on "chill."

Speaks of having observed a piece of a car wheel that passed through the cupola without melting,

"except a little of one end; it was dropped to the bottom of the cupola and laid there in the hot coals all night; that drew the temper out of the wheel; by temper, I mean the chill."

Cross-Examination.

Can't tell why this piece did not melt, nor how high it had been heated, but from its appearance would say it had been heated to a red heat. Rec., p. 129.

Worked at Starbuck's from 1840 to 1845, or prior to that time. Never had any annealing process there to my knowledge; never pitted a wheel there; they did not require it; they were a split hub wheel.

He never took car wheel, or other castings, red hot from moulds, covered it with charcoal and sand, with breathing holes.

Should have known if any such process had been performed.

Manufacture of car wheels is distinct in this way; not one man in a thousand can make a good car wheel.

Never saw Whitney's process practised

"First solid hub wheel I knew anything about was Eddy's, of Waterford: he made the double plate, or convex and concave wheel."

George G. Lobdell's Testimony.

Age 48; residence Newcastle Hundred, Delaware; occupation, Founder and Machinist. Printed Rec., pp 130-131.

Have been engaged in making cast iron car wheels since about Oct.' 1833.

"I have known small pulleys to be placed in iron vessels, or any old pot, with charcoal and iron trimmings packed around them, and this pot placed under the cupola, the contents of the cupola hauled out, covering the pot, both for the pur- Annealing processes prior to 1847.

pose of making them soft, so that they could be turned easily, and for the purpose of preventing the arms from fracture.

"The cause of the fracture of the arm of a pulley, was because one part remained hot longer than the other; consequently, the hub being the heaviest part of the pulley, and the last to cool, would produce a strain on the arm when it cooled or contracted. This process caused all parts of the pulley to cool alike.

"I don't think I ever knew it to be applied to large castings." * * *

"It could have been applied to larger castings by having a vessel large enough to contain the casting, and a sufficient amount of heated material to heat the vessel and contents.

"I cannot speak of what others knew; but I presume iron founders generally knew the cause of the fracture of castings, and could have applied the same means to prevent it that I did.

No. of car wheels made by Lobdell.

"I can hardly tell you how many I manufactured per year; sometimes two hundred a day; seldom less than one hundred a day.

"At times I have not been able to fill the demand for my wheels. I have been longer in the business than any other manufacturer of chilled railroad car wheels in this country, and consider my wheels superior to those manufactured by Messrs. A. Whitney & Sons, or any other manufacturer."

Lobdell's process of annealing car wheel.

Q. 9. Please state whether you have any process for annealing or prolonging the time of cooling your wheels, and if yea, what that process is?

A. I have. It is by taking them from the chill as soon as they can be handled, and covering them up with hot sand.

* * * * * * *

"There is no preparation of the sand other than to have it perfectly dry and heated to a certain degree; the wheels are placed in contact, as near as possible, in cooling, no additional heat being applied but that which is in them when deposited, and in the hot sand."

* * * * * * *

Effect of Lobdell's process.

"By this process, the different parts of the wheel cool at the same time; consequently, there is no strain or tension on any part of the wheel, and the wheels are strong and durable."

Commenced this process December, 1847, or January, 1848.

Cross-Examination.

Knew small pulleys to be heated as stated in answer to question 3, in 1833, and prior.

How far the process was generally known cannot say. This process was practised when necessary to do so.

"It was sometimes necessary, when pulleys had straight instead of curved arms, and hubs relatively heavier than the rim of the pulley; it was convenient

to treat all such pulleys in this way that were not too large in diameter, requiring too large a vessel to hold them, in which case frequently the hole which was cast in the hub of the pulley would have water poured into it to cool it."

* * * * * * *

These pulleys were generally small; probably not exceeding fifteen inches diameter.

Commenced to make chilled cast iron car wheels, October, 1833. Never applied the mode described in reference to pulleys to a cast iron car wheel.

Am the inventor of the Bush & Lobdell wheel, the plates of which are convex on outside.

The hubs were cut apart transversely to allow for unequal concentration.

"This was the wheel I made before adopting the process of cooling by covering with hot sand. It was not necessary to use the sand process with this wheel."

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"To make these wheels without dividing the hub, it became necessary to use some process by which the time of cooling would be prolonged, which was done by covering them up in dry, hot sand." * * * *

"I now make, in addition to these, a single plate wheel, with arms or brackets on one side of the plate, extending from the hub to the rim. These wheels are cooled in the same way.

Sand heated only enough to make it dry.

"From the time first commenced this process of annealing car wheels, I heated the sand only sufficient to insure its being perfectly dry."

Consider Whitney & Son's wheels very good wheels; better than those made by a great many other makers.

Lysander A. Orcutt's Testimony.

Age forty-eight; residence Watervleit, N. Y.; Manufacturer of Foundry Facings.

Printed Rec., pp. 133-137.

Commenced moulding and casting in 1835, and have been in the business ever since.

Believe am practically acquainted with every branch of the foundry business; have also tried to study it as a science.

Formerly made it a point to visit yearly some of the large iron establishments in the United States, for the purpose of ascertaining what there was new, and perfecting my own knowledge of the science.

Have been in Whitney's establishment, and seen his process.

Being asked as to his opinion of the two processes—Whitney's and Mowry's—says:

"I consider them quite unlike in most respects. Whitney's process, as I understand it, consists in heating up the pits, previous to putting the wheels in, after which the heat is continued and increased, the effect of which would be, if

Whitney's & Mowry's processes not similar.

Whitney's process would injure or destroy the "chill."

increased to the point set forth in his claim, to injure or destroy the chill of the wheel.

No re-heating in Mowry's process.

"The other—Mr. Mowry's process—the pit is cold when the wheels are put in, and being packed in common charcoal, the quantity would be insufficient, under any degree of ignition, to raise the wheels beyond the degree of heat they were at when put in; consequently, there would be a decrease in the heat of the wheels from the moment they are put in until they are reduced to a black heat—until all the red appearance is gone."

* * * * * * *

"The effects would be quite different so far as the chill is concerned: effecting the equalization of strain they would not be unlike."

Annealing processes as practised by Orcutt in 1840 and subsequently.

Describes processes of annealing iron castings in 1840, and subsequently: says he annealed castings far back as that time by taking them red hot from their moulds, and sometimes covering the thin parts in dry sand while exposing the thick parts to currents of air and sometimes water; at other times laying charcoal around the thin parts and igniting it, the thick parts being exposed as stated. At Starbuck's, in Troy, from 1840 to 1848, small castings of unequal thickness were sometimes taken soon as could be handled from the moulds and put into the core oven, which had been previously heated, and were there left until they cooled down.

Cross-Examination.

Printed Rec., pp. 135-137.

The treatment of chilled castings is a distinct branch of the iron founding art, and is attended with difficulties not encountered in ordinary casting branches: a process for treating ordinary castings in some respects might prove inadequate for advantageous treatment of chilled castings.

In Mowry's process the pit would not be entirely cold after the first wheel was put in. The heat would not increase as the successive wheels and charcoal were put in.

Experiments as to increase or decrease of heat in process similar to Mowry's.

"+Q. 11. Do you mean to say that a red heat of metal is greater than the heat of ignited charcoal?

"A. I do. I know that from a series of experiments which I tried by packing wheels in charcoal, quite similar to Mowry's process. I inserted copper tubes down in the charcoal at the bottom of the pit, and filled the pit full of wheels and charcoal; replenished the charcoal as it burned away with a free access of air to the coal at the top of the pit: I then tested the heat as it escaped from the tube by a thermometer, and likewise by inserting a vessel into the top of the tube with a given quantity of water at a given temperature, and noticed the time

it required to bring it to a boiling point; repeating this once in perhaps ten or fifteen minutes, for several hours.

"For the first half hour, perhaps, there was a rapid falling off of the heat.

"I repeated these experiments a great number of times, and found that invariably the case. I also tried other modes: I constructed a pyrometer which indicated a like falling off in the heat."

Don't know that the white heat of metal is less than the heat of flame.

Experiments proved that wheels had lost heat.

The top of the oven was covered up deeply with ignited coal; no plates over it; tried it covering the top with sand.

In 1844, and subsequently, applied the charcoal by packing articles in it. In some of these castings the rim was frequently crystallized and white, and hard as when cast against a chill.

Car wheels were made at Starbuck's about 1839: don't remember of any annealing process being applied to them.

Irrespective of the degree of heat as prescribed in Whitney's Patent, thinks his process and Mowry's substantially similar.

Cross-Quest. 23.

"Mr. Whitney's process, if carried out as set forth, destroys the chill of the wheels, while Mr. Mowry's process would not impair the chill at all. Respecting Mr. Whitney's process I know that such is the case. I have broken up many hundreds of his wheels that have been in use, and I have found frequently no chill in some parts of the wheel when it was evident from the deep chill in other parts that the chill had been destroyed by the application of heat, and that if Mr. Whitney raises the heat to a point just below fusion, and maintains it there for 30 minutes, I think the chill would be so far destroyed as to admit of turning, drilling or filing with ordinary tools. I have tried many experiments myself in taking out the chill in a forge fire, and have never failed of destroying the chill in a very few minutes without any indications of the iron melting."

Effect of Whitney's process would destroy "chill."

Experiments showing that heat will destroy the "chill."

Noyes G. Green's Testimony.

Age 37; residence Cincinnati; Mechanical Engineer, and Superintendant of Defendant's Car and Wheel Works.

Printed Rec., pp. 137–140.

Have been engaged in making and fitting cast iron car wheels for 20 years; have handled all the different patterns, &c.

Have read and understand Mowry's Patent, also Knight's deposition, and perfectly understand the process as practised at Mowry's Works.

Knight's description not altogether correct.

Proportion of wheels to size of the pit not correct; in practice the wheels just fit into the pit.

Description of process as practised by Mowry.

" He represents charcoal as being covered all over the wheel; our process is to put in about a third of a bushel laid around upon the plate of each wheel between the hub and rim, and no coal upon the outside between the wall and th rim; there is an inch and a half difference between the diameter of the wheels and that of the pit, and we watch it to prevent coal getting between the wall and the wheel. If any does get there we have a hook to pull it out.

Mowry's pits 1½ inches larger in diameter than the wheels.

" In Knight's description he says:

" After the insertion of the first wheel, and in fact immediately upon such insertion, the furnace starts into active operation, and all the wheels after the first are manifestly inserted in an already heated furnace."

And again he says:

(Although Mowry's pits may be cold; or nearly so, immediately preceding the insertion of the first red hot wheel, yet the instant that the wheel touches the bed of charcoal, it is enveloped in a body of flame and incandescent matter, but little inferior to Whitney's illustration.)

In Mowry's process the charcoal does not ignite—not one half—before the second wheel approaches it. The walls of the pit are not but a very little warmed until the pit is filled.

The draft is entirely shut off while the wheels are pitting, so that the coal does not ignite much. After the pits are filled with the complement of wheels, there is a cover that fits on top of the top layer of charcoal, and another cover is placed.

Only aim to keep the charcoal alive.

All we aim to do is just to keep the coal alive. The coal does not all get fully ignited for several hours after the pit is filled.

When the wheels are pitted,

"The hub is the hottest and the inside of the rim is second; the plate is the coolest."

Q. 6. When the pit is filled how do the contained wheels cool?

A. They cool faster at the hub and treads than they do in the plate, on account of the cold current of air rapidly passing through the eye of the wheel, and the cold walls of the pit taking the heat from the tread. The charcoal being slowly ignited on the plate of the wheels, keeping the plate a little warmer than the tread, allows them to cool together; by so doing it relieves them from all strain.

How the wheels cool in Mowry's process.

Exhibit 7. Respondent's.

Represents model of Mowry's annealing pits at his Works. Theoretically there is a damper in the pipe, but practically there is a thin plate of iron regulating the admission of air.

Temperature Mowry's wheels not raised.

The wheels in Mowry's pit are not raised to a temperature higher than when placed into the pit.

Has examined large number of wheels made by Mowry and Whitney respectively, and states that Mowry's are stronger, &c.

Cross-Examination.

+Q. 1. In answer to Q. 10 of your examination-in-chief you say: "The wheels are not raised to a temperature higher than when they are placed in the pit." Will you state what means you have taken to ascertain this, or whether your opinion, as expressed, is a mere matter of opinion? Printed Rec., p. 140.

A. In the first place, there is a current of cold air rapidly passing through the eyes of the wheels, and a very light draft of cold air passing between the wheels and the pit, so that it all the time keeps cooling the heat of the wheel, and the tread does not get any hotter by that means. I have stayed there nights to watch the annealing of the wheels, to see if the pits worked all right, and found the wheels did not raise in temperature a bit. I have taken the tube out that goes into the eye of the wheel, and looked into the pit to ascertain the temperature of the wheels. I would also state that after the wheels come out of the annealing pit, the hooks on the wheels by which they are lifted retained their white chilled appearance, and being thin, the chill would be taken out of them if they had been heated to a greater extent than they were when taken from the moulds. I would also state that if the wheels were heated to a greater degree than they were when taken from the moulds, they would show scales upon their surface after their removal from the annealing pit, and they do not show any such scales. Mowry's wheels are perfectly clean of sand when placed in the annealing pit. Means taken to ascertain that wheels were not raised in temperature.

Re-Examination.

It takes about 48 hours for the entire combustion of the charcoal.

Robert Guynn's Testimony.

Age 48; residence Cincinnati; Mechanical Engineer; have had superintendence of large manufacturing establishments in this country and Europe, also of several railroads. Printed Rec., pp. 141-145.

(Examined relative to printed publications descriptive of annealing processes, and thinks such descriptions are of processes analagous to Whitney's.)

Q. 12. You will now please state what would be the effect upon the "chill" if the car wheels were heated to a point a little below that at which fusion commences?

A. The effect would be to deteriorate the "chill," to how great an extent I am unable to say, never having experimented upon that point, but reasoning on the conceded fact, &c.

Q. 13. About how many degrees difference is there between a "red" or "cherry red" heat and a white heat in an iron casting, such as a car wheel?

A. I am not prepared to say from memory, but any of the hand-books would give satisfactory information on the subject; but my present impression is that there is a difference of 1000 degrees of heat between "cherry red" and white heat.

One skilled in art of iron founding and annealing would raise the temperature of annealing furnace, guided by Whitney's Patent, to from 2500° to 2800°.

Cross-Examination.

Attention called to a former deposition, in which, comparing Whitney's and Mowry's processes, says there would be no difference in effect, except in so far as the charcoal strengthens the iron by imparting to it carbon.

Increase of temperature would be necessary, provided the mass had cooled below that at which the natural adjustment of the particles takes place; otherwise prolonged cooling alone necessary.

Think the process of annealing described in Dobson's Encyclopedia implied re-heating.

Cast iron cannot be converted into forged by the annealing process.

Nothing in Dobson having special reference to manufacture of chilled castings.

Dobson describes a process for treatment of glass analagous to that described by Whitney for treatment of car wheels.

Do not think it would be possible to melt wheels, or raise them near the melting point, in apparatus shown in Whitney's Patent, without use of a powerful blast or the natural draft was very great.

William Wade's Testimony.

Printed Rec., pp. 157-163.

Age 77; residence Allegheny City.

Major Wade's experience in working iron.

"My acquaintance with the manufacture of iron commenced in 1813, at which time I was a lieutenant in the Ordnance Department of the Army of the United States, and it became my duty to attend at the foundries and witness the casting of iron cannon balls and shells, and to inspect the same when they were finished," &c.

Resigned from the U. S. Army in 1832; then became part owner and manager of a foundry in Pittsburg, where they made steam engines and heavy machinery of all kinds; also cannon for U. S. service; in 1834 equipped the Pennsylvania Portage R. R., and cast the cast iron chilled wheels for the road.

Attention was called, while casting cannon, to the contraction of various kinds of iron, and I devised contrivances for testing its strength, and which, together with notes of my experiments, I set forth in my reports to the Ordnance Department, and which were published by United States Government.

Under appointment from United States Government visited and examined the foundries, arsenals and armories in England, Scotland, France, Sweden, Russia and Prussia; after return was appointed to superintend casting of all cannon made for the United States; devised various instruments for testing the strength of iron, and effect on it of processes of manufacture: was ten years engaged in the studies necessary for the perfection of these instruments, and with them very satisfactorily tested the transverse and torsial strengths and its density, both comparative and absolute, and resistance to crushing. This apparatus was adopted and is now used by the Ordnance Department of the United States and by the British Government.

Continued in this service until 1862, when I resigned and re-embarked in private foundry business.

"Early in 1861 I was, for the third time, called into service by the United States at Washington, where I remained till 1864; when, after more than fifty years' study of iron and its manufacture, I resigned and retired to private life. The foundry alluded to, as the one which I superintended prior to the year 1840, was the same known as the Fort Pitt Works."

Have knowledge of the annealing of iron castings prior to 1847.

Refers to Count Rumford's Philosophical Papers, which, witness says, in 1818 directed his attention to the annealing of cannon, by slow cooling them.

Annealing processes practised at Fort Pitt Works in 1831.

In 1831, at our foundry in Pittsburg, it was common practice to anneal iron castings in a reverberatory furnace; one method was to place them, while red hot, on furnace hearth, soon as practicable after melted iron was discharged from it, and then cover them with dry sand or cinders, or keep them covered closely until the following day. Another method was to imbed them in the sand beneath the hearth before lighting the furnace fire, and to keep them in this position, where they would be

heated by the flame and the melted iron in the furnace, and where they would remain until they were very slowly cooled.

Describes the annealing of cannon at Gen. Mason's Foundry, Georgetown, D. C., 1818-19.

Has read Whitney's Patent.

Being asked for his opinion as to whether the processes known to and practised by him, as referred to, are like or unlike Mr. Whitney's, says in answer to Q. 6:

"In my opinion the process practised by me at my foundry in Pittsburgh between 1831 and 1839, in principle and mode of operation was essentially the same as that described in the specifications and Letters Patent of Mr. Whitney. The same philosophical principles were involved, and the same effects produced by the two processes. In my process the castings were placed on the hearth of the furnace in which the metal had been melted and raised to a very high degree of heat, after fusion, so that the hearth and walls of the furnace were of about equal heat to iron at its fusion point, when these castings to be annealed were placed within it. They immediately acquired heat and were raised in temperature. They were covered over with hot sand so as to exclude the air, and the whole mass raised to a still higher temperature by the heat which the hearth and walls gave off, until equilibrium was produced, when the furnace, sand and castings were cooled slowly and evenly by radiation. The castings being perfectly covered by the sand—a good non-conductor—were in a confined atmosphere, and cooled as nearly simultaneously as practicable for castings to cool.

"It is impossible to cool a casting in every part at the same time. To illustrate—a heavy bar of iron, subjected to high heat, receives compact of heat on the surface, and an appreciable portion of time is occupied in transmitting the heat to the interior portions. A mass of molten metal, exposed to the air, will first give off the greatest heat from the particles on the surface, and an appreciably longer time will be consumed by the interior particles giving off their heat. A piece of cast iron heated nearly to the melting point, suddenly thrust into a vessel of cold water, will give off the heat of the crust on the surface in an instant of time, so that the thin crust on the surface will be of the same temperature for the instant as the water, equilibrium existing between them; while the interior particles of the iron will yet be of a very high temperature, having parted with but little of their heat by conduction. The effects produced by me on the castings annealed by this process were gradual increase of temperature and as gradual cooling of the castings in the confined atmosphere as is practicable.

"In the process used in annealing the cannon at Gen. Mason's foundry, the principles involved and the mode of operation were identical with the process described in the Letters Patent of Mr. Whitney, save that the casting was not raised in temperature. The slow combustion of the charcoal acting upon the gun mould, raised the mould to a cherry red heat, it being impracticable to heat the mould to a greater degree lest it should fuse, or become ruptured, and permit the mass of molten metal it contained to flow out, thus destroying the casting.

"In my opinion, based upon my study, experience, and interchange of opinions

with the most skilled iron founders, the effect produced by *reheating* castings taken from the mould while red hot and slowly cooled or annealed, is to increase their bulk, diminish their specific gravity, and as a consequence make the iron *weaker*. I arrived at this conclusion after many experiments made through years of study on the subject, and so far as I am acquainted, this is an acknowledged law among scientific and practical men. I remember when I first made known this conclusion I had arrived at, to the late Cyrus Alger, of Boston, Mass., then at the head of his profession, and the most accomplished iron founder I ever met in the United States or Europe, that he was not prepared to accept it, but that after very careful experiment and study, he fully coincided in the opinion I had expressed, and conceded this to be a law, slowly cooling the casting from the point of congelation would not so perfectly relieve it from *inherent* strain, but would leave the metal itself *stronger*. The principles involved in the two processes are the same, differing in degree of application, and consequently in degree of effect produced.

"Q. 7. Please state what effect would, in your opinion, be produced on the chill of a cast iron car wheel heated to a point 'say a little below that at which fusion commences.'

"A. It would leave the iron composing the chill in nearly the same condition it would have been had it not been chilled; the chill would be wholly or very nearly destroyed, so as to render it altogether worthless for the purpose of a chill.

"Q 8. Please state to what degree you would raise the wheels in practising the process of annealing or cooling described in the Letters Patent of Mr. Whitney, if you were guided solely by the description and directions contained in said Letters Patent.

"'A. A point a little below fusion' is rather indefinite, assuming Daniell, who gives about 2786 degrees Fahrenheit as being the fusing point of cast iron. I would raise the wheels, by the direction of Mr. Whitney's Letters Patent, to about 2600 degrees Fahrenheit—and I may add, that raising them to this point, would be 1200 or 1500 degrees more heat than would be necessary to destroy the chill. I have no doubt at all that 1500 degrees of Fahrenheit would destroy the chill in a cast iron car wheel."

Mowry's process different from Whitney's.

Have read Mowry's Patent and understand the process described in it, and think it differs materially from Whitney's; that there is no reheating in Mowry's process; that the cooling of the plate is retarded by the ignited charcoal; the cooling of the rim hastened by its contiguity to the wall, and of the hub by the cold air. If the means employed are duly proportioned to the varying masses of metal, all the parts will cool down simultaneously.

Effect of Mowry's process not same as Whitney's.

The effect of Whitney's process will be, that the high temperature (assumed to be 2600°, the melting point being 2786°,) will destroy the hardness of the chill, increase the bulk, and consequently diminish the density of the metal and lessen the strength of the casting. The inhe-

rent strains will be prevented, but the strength and durable wear will be thereby greatly diminished.

By Mowry's method the chill will be unimpaired, because the temperature of that part of the wheel is not increased after it leaves the mould; and all parts of the wheel being cooled equally, inherent strains will be prevented, and the wheel will retain all the strength and hardness due to the material of which it is composed.

Narrates in detail experiments and results thereof made for purpose of ascertaining the effects produced on cast iron by hastening or retarding its cooling when cast, or by reheating and cooling it after it had been cooled.

First learned that re-heating would destroy "chill" about 1849.

"It first became known to me that re-heating and annealing cast iron would destroy or impair the chill about the year 1849, and I am not aware that it was known to others before that time; I am not able to state the exact date. It first became known to me that the slow cooling of iron, when cast, would impair its strength, in the year 1845, when experiments then made by myself demonstrated it."

Joseph Kaye's Testimony.

R. c., pp. 164-7.

Age 52; residence Pittsburg; Foreman of Fort Pitt Foundry; began as apprentice to moulding business in 1824; then worked as journeyman moulder until 1842; then became foreman Fort Pitt Works, and have been ever since. * * * *

"Have used all the various processes known in the manufacture of all kinds of castings, both heavy and light, including both land and naval ordnance."

* * * * * * *

"I have manufactured the machinery for and equipped railroads, gunboats, steamboats, iron mills, glass manufactories, and other mills, and in brief I believe I have manufactured whatever is made out of cast iron. I have very carefully studied and performed many experiments of various kinds to determine the nature and properties of the various kinds of iron, their absolute and comparative strength, and the effects produced upon iron by the various processes of manufacture. I have frequently been applied to for information by scientific and practical men throughout the United States, and also by Commissioners from the various Governments in Europe."

Manufactured hundreds of wheels by Whitney's process.

Have read Whitney's Patent, and have manufactured hundreds of car wheels by the process described in it, about the year 1849.

Am acquainted with various processes for annealing or slow cooling of iron castings in use prior to 1847.

"As long ago as 1837 I cooled cog wheels two feet in diameter, pulleys and

other castings, by taking them red hot from the moulds in which they were cast, and immediately placing them in the ash pit of the furnace, and raking down a large quantity of red hot coals upon them, completely covering them, and permitted them to remain there until the whole cooled by radiation, which occupied about one day.

Annealing processes practised by Joseph Kaye.

"This was a common practice in Pittsburg at that time.

"In the year 1847, I cooled an oil receiver, of cylindrical shape, weighing about thirty-five hundred pounds, by taking the same from the mould in which cast, placing it on a carriage, and running it into a core oven, previously heated as high as the casting, with the oven containing fuel, when the doors of the oven were closed, and all draft shut off, and the whole mass left to cool by radiation, which occupied between thirty-six and forty hours.

"In this same core oven, about the same time, I cooled wheels which were too large to be placed in the ash pit of the furnace, and weighing six or seven hundred pounds, by taking them from the moulds while red hot, placing them in an oven supplied with fuel, closing the oven and shutting off all draft, and allowing the whole to cool by radiation, which required between thirty-six and forty hours. I practised this at our Works in Pittsburg."

* * * * * * *

"The term 'anneal' is very frequently used to indicate a process of cooling of any kind.

"Strictly speaking, to anneal a casting is to re-heat the casting gradually, by this means making the iron homogeneous, increasing it slightly in bulk, making it softer, diminishing its specific gravity, and making it, consequently, weaker. A process of slow cooling, in which the casting is not reheated, and the iron in which is not made homogeneous, nor its specific gravity reduced, nor the iron made soft, is not, correctly speaking, annealing, but slow cooling."

* * * * * * *

Q. 7. Please state what, in your opinion, would be the effect produced upon the chill of a cast iron car wheel, if the wheel were raised to a degree of heat, say "a little below that at which fusion takes place," and the same was then allowed to cool gradually in the space of three or four days.

A. Unquestionably the properties of the chill treated in such a manner, would be wholly destroyed, which I know from various experiments made by me to determine the matter.

Whitney's process would unquestionably destroy the "chill."

Q. 8. Please state any experiments you have made to test the effect of heat upon the chill of car wheels; describe the same fully, and give the results of your experiments.

A. In the year 1849, I think it was Mr. Totten, one of the proprietors of our Works, obtained from Mr. Asa Whitney license to manufacture cast iron car wheels by his patented process.

I was at that time furnished with a copy of the Letters Patent of Mr. Whitney, with drawings and patterns for the ovens and wheels, fur-

Use of Whitney's process by Kaye at Fort Pitt Works under license, and the destruction of the "chill" thereby.

nished by Mr. Whitney, and strictly in accordance with these I manufactured an hundred wheels for the Pittsburg & Cleveland Railroad, which were shipped to Ravenna, Ohio, some four months afterwards; these wheels were condemned by the President of the Road for being soft in the chill.

We had a lot of wheels in the yard of the same kind, made at the same time, of the same iron, and in the same manner. The President of the Railroad, Mr. Prentice, with Mr. Charles Knap, one of the proprietors of our Works, came to me and informed me of the chills being soft. I thought this could not be, as I had broken one every day while we made them to see the chill, which always appeared to the eye to be very good. I immediately took these gentlemen to the yard, and caused one of the wheels, taken from the stock promiscuously, to be broken, which had the appearance of a good chill so far as could be detected by the eye; after reflecting and conversing on the subject, it occurred to my mind that the heat applied in annealing the wheels might have had some effect on the chill, when I at once procured a file, and was surprised to find that the file readily cut the chill on the wheel. We broke four new wheels at the same time, in all of which the chills presented a good appearance to the eye, but were all readily cut off by the file. I also, at the same time, took a chisel and chipped easily the chills, right on the face of the tread. We at the same time tried the stock of wheels in the yard, and found all of them could be readily cut by the file, or chipped with the chisel; some of them being a little harder than others.

Afterward I made a peep hole so that I could see into the furnace, which I heated only to a very dull heat, then placed the wheels in the furnace, shut the damper and allowed the wheels to cool slowly; which modification and contrivance improved the quality of the chill, with now and then a cracked wheel at the top of the pile in the furnace.

We made about 2000 wheels by this process, when, finding it impossible to produce a good wheel with the chill unimpaired, we abandoned the manufacture by this process. A few days after the experiments made with Mr. Prentice and Mr. Knap, I attracted the attention of Major William Wade to the case of the chills being destroyed in the wheels, and with him re-tested them, by cutting with a file and chipping with a chisel, and together we sought to ascertain the cause of the destruction of the chill.

To this time, so far as I am informed, scientific and practical men were ignorant of the fact that a heat less than fusion would destroy a

chill in cast iron. My attention had not been attracted to that before, nor have I ever met with any one who was acquainted with the fact, prior to that time.

Experiments by Major Wade & Kaye as to effect of heating and cooling castings in various ways. Chill will be removed by a "bright red" heat.

I at once began experimenting, and witnessed a series of experiments planned by Major William Wade, with a view to test the effects of heating and cooling cast iron in various ways, with special reference to their strength, hardness and density of the metal, which experiments clearly demonstrated that the hard chilled character of cast iron would be removed by heat less than fusion, not greater than a bright red heat; since which time I have a thousand times demonstrated the same fact in my daily business in various ways.

Q. 9. Please explain what was your object in placing the peep hole in the furnace of Mr. Whitney at the time you were using his process, as stated in your last answer.

A. In using the quantity of coal directed in the Patent of Mr. Whitney, I found that in practice it frequently produced so much heat that the bottom wheel of the pile in the furnace was fused; the Patent provided no means whereby this fact could be detected until after the furnace was emptied. I adopted the peep hole to enable me to look in and see the quantity of heat being produced, that I might provide against their destruction by being fused.

Q. 10. Please state whether or not you have read and understand the contents of the Letters Patent granted to Albert L. Mowry, on the 7th day of May, A. D. 1861, an agreed true copy of which is now shown you, and annexed hereto, marked "Exhibit B."

A. I have read and examined the Letters Patent of Mr. Mowry, and I think I understand the contents of the same.

Q. 11. Please state what difference, in your opinion, exists, if any, between the process described in the Letters Patent of Mr. Whitney, and the process described in the Patent of Mr. Mowry, in their principle, their mode of operation and the effect produced.

Mowry's and Whitney's processes essentially different from each other.

A. In my opinion the processes are very different, both in the principles involved and their mode of operation and the effect produced. Both processes, in one respect, produce the same effect, namely: both prevent the wheel from rupturing in cooling. In doing so the Whitney process makes all parts of the wheel soft, diminishes the specific gravity of the iron to a greater degree, and of course weakens it. The Mowry process does not increase the heat of the wheel, does not diminish the specific gravity of the iron, does not soften the wheel in every part, does not impair the chill, but rather improves it, by permitting it to cool gradually and more rapidly than the plate, the tread and flange

being nearer to the cold walls of the pit, which absorb the heat very rapidly, are cooled faster than the other parts, thereby perfecting the chill, which was first created by the same principle of more rapid cooling. In the Mowry process, unlike the Whitney process, the current of air accelerates the cooling of the hub, which, if caused even in the smallest degree, will be beneficial in relieving it from inherent strain and retaining the strength of the iron.

The Whitney process is nearly allied in principle to that used in cooling heavy ordnance by us some years ago. We then attempted to secure all the heat in the gun pit, and retain the same for the longest possible time, it having no other way of escape than through the earth. A gun of ten tons' weight, cooled in this way, in the space of ten days, would be ruptured after being fired, with the ordinary service charge, between two and three hundred times.

The Mowry process is analagous to that now used by us in manufacturing ordnance, wherein we pass a current of cold air or cold water through the bore of the gun, accelerating the cooling of the central portion and retarding the cooling of the outside, so that all parts, in the end, may be cooled simultaneously and alike. By this process we cool a gun of ten tons' weight in four days, which will bear the strain imposed by firing from 1000 to 1500 rounds with the ordinary service charge.

JOSEPH KAYE.

Edward S. Wayne's Testimony.

Rec. pp. 168–174.

Age 48; residence Cincinnati; Chemist; familiar generally with the manufacture of iron.

Have read Patents of Whitney and Mowry, and understand the processes.

Differences between Whitney's & Mowry's processes.

"In my opinion, the two processes differ widely, and for the following reasons: In Whitney's Patent, the wheels are taken from the flask or mould as hot as possible, then placed in a furnace or oven that has been previously heated, and an arrangement made whereby the heat may be kept up by a furnace, or otherwise, and the wheels then and there heated to a much higher point than they were when placed there. Whitney mentions that the point necessary for them to be raised to for the accomplishment of his Patent or process is that of incipient fusion. In Mowry's process or Patent, the wheel is taken from the mould as hot as possible, placed in a cold pit, surrounded more or less with charcoal on the top of the plates, and when the pit is full, covered, and a slight draft formed through the mass, or through the eye of the wheel. The ignition of the charcoal is caused by the heat in the wheel when placed there. It is sufficiently hot to ignite it. A slight smouldering combustion is thus formed, and is not, in my opin-

"Smouldering" combustion in Mowry's pit.

ion, great enough to cause the generation of any amount of heat superior to that of the wheels when placed in the pit. I think that the wheels cool gradually from the time they are placed in the pit until they are taken out; the combustion of the charcoal merely retarding the cooling to a certain extent."

Think Whitney's process same as the processes described in Exhibits Nos. 1, 3, 4, 6 and 7. In both cases of glass and iron, the only object in heating them and cooling them slowly, is to give the material time to arrange itself in such a manner that no undue strain or fracture may occur.

Whitney's process same as those described in Exhibits 1, 3, 4, 6 and 7.

Whitney's process different from those described in depositions of Orcutt & Lobdell; those are slow-cooling processes: in Lobdell's there are slight approximations to Whitney's process; the contents of the cupola may cause to a certain extent a re-heating of the wheel.

Am satisfied "chill" would be destroyed if wheel heated to a point a little below that at which fusion commences, would destroy the "chill;" and that any re-heating of the wheel in the pit would result in injury to the chill.

"Chill" would be destroyed if heated to a point "a little below that at which fusion commences."

Have experimented as to effect of heat on chilled cast iron, and found that a continued heat much below incipient fusion, continued even for ten or twelve hours, perfectly destroys the chill.

Experiments as to effect of heat on chill.

The heat I applied was a bright red heat: should think the temperature not over 1200° or 1300° Fahrenheit. Incipient fusion would be 2500° to 2700° Fahrenheit.

"Cherry red" indicates between 1000° and 1100° Fahrenheit.

"Cherry red" about 1000° Fah. to 1100°.

Think in Mowry's process the charcoal acts as a storehouse of heat to the plates: that a uniformity of temperature is preserved; the combustion is merely a smouldering one.

In Mowry's process the charcoal acts as a storehouse of heat to the plates.

Opinion is, wheels are of uniform temperature when taken from the moulds; and from observation would say, when taken from moulds they have heat to about 900° to 1000° Fahrenheit.

Produces Exhibit "9," and describes experiment as to effect of heat on chill.

Exhibit "9," specimen of iron with "chill" from ¼ to ⅝ inches deep, which was subjected to 1400 to 1500° fah., and the "chill" thereby destroyed.

There is a difference between the process described in Whitney's Patent and that practised at his manufactory, as described in the testimony of his foreman, Henry Snyder.

A wide difference in temperature between a "cherry red" heat, and a point a little below incipient fusion.

I should say in degrees, it would be from 1000° to 1200° Fahrenheit.

Difference between process described in Whitney's Patent and that practised by him. 1000° to 1200° Fah.

Cross-Examination.

The various degrees of temperature I have given are given as ap-

Rec., p. 173-4.

proximations. I do not consider them absolutely reliable. I have approximated the temperatures mentioned in the text books for "red heat," "white heat," "incipient fusion," &c.

Think, in furnace described by Whitney, the wheels could be raised to incipient fusion.

Have not seen, in any of the exhibits shown me, any process described for the application of annealing or slow cooling, as a stage in manufacture of car wheels.

Richard Bromley's Testimony.

Rec., p 174-5.

Age 45; residence Hamilton Co., Ohio; Master of Machinery Little Miami, Columbus and Xenia Railroad.

Has read both Patents, and thoroughly acquainted with Mowry's process as practised by him.

Mowry's and Whitney's processes substantially unlike each other.

Thinks the processes are substantially unlike each other, and gives his reasons therefor. Has used large numbers of wheels made by the two patentees, and has clearly observed a difference in effect on the chill. "In the chill and anneal, and wearing properties, the Whitney wheel is inferior to the Mowry wheel."

William Clough's Testimony.

Rec., pp. 177-192.

Age 45: residence Cincinnati; Consulting Engineer and Solicitor of Patents; have been proprietor and manager of various manufacturing establishments, among them, extensive railroad car factories, in which used several thousand wheels, which were made under my direction.

Mowry's and Whitney's processes not the same in principle.

Practically no re-heating in Mowry's process.

Whitney's process would destroy or seriously injure the "chill."

Has carefully examined Mowry's process at his Works.

Knight's description of it not correct.

No body of flame &c.

The combustion is and must be "sluggish."

Whitney's Patent discloses nothing new in principle.

Is then examined relative to the processes of Whitney and Mowry, and expresses the opinion that they are not the same in principle; that in Mowry's there is practically no re-heating; also, that Whitney's process, as described in his Patent, would destroy or seriously injure the chill. Has carefully examined Mowry's process as conducted at his Works; that the deposition of Mr. Knight, in respect of the "body of flame," "incandescent matter," &c., and degree of heat, "could not theoretically and practically—according to my observation, does not exist. The combustion is, and must in the nature of the case, be sluggish."

Thinks if, after wheel is placed in the annealing furnace, the temperature was raised to a point "a little below that at which fusion commences," the "chill" would be destroyed.

Thinks, in view of the Exhibit references, that Whitney's process includes nothing new in principle.

Cross-Examination.

The term anneal is variously applied to processes which differ in degree, though all correspond in kind. The term anneal "is variously applied."

The process, as applied to treatment of car wheels, and as is generally termed "annealing," does not destroy "chill."

Do not find in the references description of a process, as applied to purposely induced "chilled castings." The Exhibits do not refer to articles which have purposely induced "chill."

Not Whitney's object to destroy chill; destruction of chill gradual; at white heat might require some weeks to entirely destroy chill. Not Whitney's object to destroy the "chill."

If temperature, raised to a point "as high as practicable, without melting or fusing the metal," and then suffered to cool gradually, entire process being completed in three days, the chill would be modified or impaired; do not think Whitney contemplates destroying the chill, but the language of his Patent implies distinctly the raising of the temperature of the wheels to a point which would destroy the chill. Strain commences as soon as all parts of the wheel become hard; after losing a few hundred degrees of heat from fusion point. Whitney provides for re-heating the whole structure, Mowry only the plate; both use pits; both create artificial heat in the pits; in both the active operation of the fuel is at the commencement of process; in both the process occupies three or four days.

Do not find in any of the references the application of annealing process to car wheels by name, except as they are included in general term, "iron castings."

(From +Q. 33 to end of deposition, the witness is interrogated about the references, Exhibits 1, 3, 4, 5, 6.) Nothing is elicited, as is believed, other than what is apparent in the face of the Exhibits. Rec. p 188.

ASA WHITNEY
vs.
ALBERT L. MOWRY. } In Equity. No. 534.

TESTIMONY ADDUCED BEFORE THE SPECIAL MASTER, UNDER THE ORDER OF REFERENCE TO HIM TO STATE AN ACCOUNT OF PROFITS AND GAINS.

Asa Whitney

Testifies—Wheels made under his Patent are cheaper, having an average of ten pounds less weight than those made in the ordinary way. Record, pp. 194-197.

Second. The purchaser has this amount of metal less weight to trans-

port during the life of the wheel, making this item of saving of transportation $5 per wheel. *Thirdly.* The wheel is more durable, because we can make it harder and freer from all inherent strain, and consequently the wheel sells more readily, at least by a difference of $1 per wheel, than those made in the ordinary way.

License by Whitney to Whitney & Sons from 1850 to 1861, both inclusive, at $1. per wheel.

Testifies to sale or license made by him to firm of A. Whitney & Sons, at $1 per wheel, and that from 1850 to 1861, both inclusive, he was paid $1 per wheel, aside from his proportion of the profits of the business; annexes a tabular statement from books of said firm (Exhibit—"Royalties"), showing the payment to him in the aggregate of $237,194.

That with exception of two licenses, one in 1849 and one in Jan., 1851, he has retained the exclusive right under his Patent; that no wheels were made under the license of 1851, and only a few under that of 1849, and it was cancelled.

William Helme.

Rec., p. 197.

Age 43; residence Philadelphia; Machinist and Superintendent Whitney & Sons' Works.

Am familiar with process of manufacturing car wheels prior to 1848; they were made with spokes and their hubs divided into three parts to allow the arms to shrink from the centre to the circumference; when wheel was cold openings in hub filled with wrought iron kegs or composition; then wrought iron band shrunk on each end of the hub; the wheel was then bored.

The wheels described were cooled in the open air same as other castings thrown out of the mould; and the wheel would require 25 to 30 pounds of wrought iron, and a blacksmith and helper would band and finish about 3 or 4 wheels a day; labor of blacksmith and helper would cost $4 to $5 per day, and the iron was worth about 5 cents a pound.

Am familiar with Whitney's process, and by it the whole of the labor and material above specified is saved.

Cross-Examination.

Do not mean to say that, prior to 1848, all car wheels were made with divided hubs. Did not know, prior to 1848, of solid-hub wheels, except double-plate wheels.

Have known of such wheels made and cooled in hot, or dry sand: known it used by Lobdell, of Wilmington, about 1861 or 1862.

The Whitney process costs the difference of the fuel used.

Re-Examination.

I know of manufacture of double-plate wheel with hub divided transversely to the axle; know of their being made by Bush & Lobdell. Have no means knowing comparative numbers of solid and split-hub wheels prior to 1848, but don't think there were 10 per cent. of solid hub wheels made; don't think any split-hub wheels made now; no doubt ten times as many wheels made now as prior to 1848.

Samuel First.

Book-keeper for A. L. Mowry since 1862. Rec., p. 200-5.

Presents day book and says same contains a correct account of all car wheels sold from the establishment: entries in year 1861, and up to 1863, specify whether the wheels were annealed or not; after January, 1863, no specification was made, and wheels sold, with here and there an exception, were all annealed.

No annealed wheels have been sold since May 28, 1867; think have 375 to 380 annealed wheels on hand. The book contains entries of sales of cars, without statement as to wheels to car. There are 8 wheels to a car, 33 inches diameter, unless otherwise specified.

Have stated that after Jan., 1863, the wheels sold were annealed; two exceptions to be noted in 1863, one of 76, 30-inch truck, at $14 50, in August; and September 1st, 24, 24-inch wheels, for $10 50.

Corrected Statement—Wheels on hand numbering 423.

Sizes made by Mowry:

33 inch
30 "
28 "
26 "
24 "
} Car and truck wheels.

Cannot state the weights, and the books do not show. Cold blast iron was only kind used. Books will show how much iron purchased each year and at what price; will make out and annex statement as to this, also as to charcoal used and labor employed, repairs, cost of pits and patterns, and their present value, so as to show actual cost of each size of wheels in each year.

Prices as stated in books for wheels represent the gross sales, cost of delivery, commissions to agents; Government taxes are to be deducted; will make and annex a statement.

Cross-Examination.

Have never made an accurate statement of the profit derived by Mowry from manufacture and sale of wheels.

Have made approximate estimates of profit—one in 1863 and one in 1865—based on cost of iron and labor, use of machinery and all incidental expenses, including interest on capital, Government tax, delivery, &c.

The result was that the profit on a wheel was 50 cents; this was profit on a 33-inch wheel; made no estimate of any other; think this exhibited profit correctly; made July, 1863, and February, 1865.

Interest was estimated on ⅔ of $135,000, at 6 per cent.

Results of estimates not exactly the same; gives details of calculation.

Requires nine men, not including the engineer or fireman, to make three wheels per day; same force will make eight wheels per day; would require four additional men to make sixteen wheels per day; two extra men required for more than eight and up to twelve wheels per day; above that four extra hands.

Noyes G. Green

Rec., p. 206.

Gives average weight of wheels made by Mowry, as follows:

33-inch	double	plate	.....	505	pounds.
" "	single	"	.....	485	"
30 "	double	"	.....	475	"
" "	single	"	.....	425	"
28 "	double	"	.....	380	"
" "	single	"	.....	350	"
26 "	double	"	.....	330	"
" "	single	"	.....	280	"
24 "	double	"	.....	310	"
" "	single	"	.....	280	"

Samuel First

Submits statement of expenditures for repairs, amounting to $2,541.31.

A. L. Mowry

Mowry's process before that complained of, simply slow cooling in pits without fuel.

Commenced the manufacture of car wheels at Cincinnati in 1851, and have been engaged in the business ever since.

Prior to use of the process patented to me (complained of), usually cooled my wheels in pits covered with dry sand; in some cases I have

used air-tight pits without any sand, placing the wheels in the pits and allowing them to remain there three or four days.

Since injunction in this suit have used the pits without using any fuel; cover them up; leave the wheels in four or five days. Never made any change in quality of iron; always used the best quality of cold blast iron, which costs $10 per ton more than hot blast; always used a small amount of iron of old wheels, but in buying new iron, always bought cold blast iron.

Quality of iron always the same.

Never made any change in weight of wheels; those made before adopting the process complained of, during that time and since stopping its use, were of the same form and weight.

Forms and weights of wheels same always, no change by reason of use of process complained of.

Seldom made single-plate wheels, except when specially ordered.

Business never increased by reason of use of process complained of; never sold wheels any more readily; it made no difference in prices; in fact it was with difficulty I introduced the wheels so made.

Business never increased, nor prices exchanged, by reason of process complained of.

Since injunction and abandonment of the annealing process, have the same customers, and have sold as readily and at same prices as before.

The annealed wheel is most expensive to make by reason of the fuel; always calculated that it cost 25 cents more.

"EXHIBIT A, L, M, 1."

Sizes and Weights of Wheels.

KINDS OF WHEELS.	Tr'd	24	26	27	28	30	33	36
For Engine, Truck and Tender, Passenger, Freight, and other Cars of ordinary trains, single plate.	3½	288	318		361			
	4	300	328		372	440	488	
	4½					476	519	
Double and single plate combined for Engine, Truck, and Tenders for fast trains and heavy service.	4	300	324		386	476	505	
For Sleeping Cars, made by special service by order of one railroad company.	4¾						566	
Single-plate Street Cars,	1¾				169	191	198	
	2¼			158		204	208	266

A. L. MOWRY.

"EXHIBIT A, L, M, 2."

Comparison of average weights of wheels of same sizes and classes as per statement in deposition of Asa Whitney of August 27, 1867, and actual weights of A. L. Mowry's wheels, as per statement, averages being based on weights of twenty wheels.

Size of Wheels.	Av. Weights of Whitney's Wheels.	Av. Weights of Mowry's Wheels.	Diff. in favor of Mowry's Wheels.	
	ORDINARY.			
24	335	296	39	
26	365	323	42	
28	412	366	46	
30	460	458	4	
33	530	504	26	
	HEAVY SERVICE.			
26	376	324	52	
28	430	386	44	
30	480	476	4	
33	550	505	45	
	SLEEPING CARS.			
33	585	566	19	10 wheels, weighing 319 lbs. less, making an average of 31 9-10ths lbs. in favor of Mowry's wheel, and in the iron at 4c. per pound, Mowry's wheel would cost $1 27-100, 6-10ths less.
10			319	
	STREET CARS.			
27	180	158	22	
30	210	198	12	
33	275	203	72	
36	305	206	39	
4			145	4 wheels, weighing 145 lbs. less, making average of 38¼ lbs. in favor of Mowry's wheel, with iron at 4c. per pound, Mowry's wheel would cost $1 33-100ths less.

A. L. MOWRY.

The way I got my weights was by weighing quite a large number of wheels when Mr. Green and I were both present.

Published a circular in 1861 or 1862, stating advantages of my patented process, and warning railroad companies not to purchase from John Nash, because he used it; brought suit against Nash.

Perhaps made more wheels in 1862–63–64 (after process complained of) than just prior to 1861 (before process complained of), but not as many as between 1855 and 1858, I think.

During the war there was a greater number of wheels required.

All the roads supplied by me have, at times, used the Whitney wheel; also other makes: they have bought where they could do best. Never made it a feature in my business to make my wheels or prices with reference to competition of the Whitney wheel.

Have had more competition with Lobdell and others than with Whitney; Whitney's wheel being a single-plate wheel, and mine a single and double-plate combined.

Changed from the cooling process to the combined annealing and cooling process, by reason of impression that I could make a stronger wheel by using charcoal, and thereby increase my business, but result did not justify the impression.

In using sand process, wheels left in the pits four days usually: sometimes, when inconvenient to take them out, left them in five days.

Many manufacturers only leave them in three days.

I make a wheel that is called the Washburn wheel—not exactly after his Patent; have a right under his Patent to make it; since injunction, have made the same wheel as before—the Washburn—more properly the Atwood wheel.

Have a right under the Washburn Patent; make the Atwood—Washburn—wheel.

Daniel McLaren.

Residence Cincinnati; Superintendent of Cincinnati, Hamilton and Dayton, and Dayton, Michigan and Cincinnati, Richmond and Chicago Railroads. Rec., pp. 211-219.

Have been purchasing and using car wheels, in connection with the roads designated, ever since 1851. Have purchased from Mowry wheels designated as annealed wheels; also, prior to his patented process, we purchased from him wheels that were slow cooled, without extraneous heat: should not be surprised if we did afterwards, "for I opposed his annealing process."

"I would not give a cent more for the annealed wheel than the unannealed wheel; but in certain patterns of wheels would give more for the unannealed wheel than for the annealed wheels.

"Annealed" wheels worth no more than "unannealed" wheels.

Preference given to "Washburn" wheel.

"I would prefer a Washburn wheel made from a proper pattern, unannealed, to any annealed wheel I have seen, because I consider that annealing spoils the chill of the wheel.'

Cross-Examination.

Should say that annealing by re-heating makes the iron tougher and stronger, but it damages the chill; am not willing to admit, as regards safety, that the annealed wheel would be better.

Have bought Whitney's wheels; Mowry's wheels have been cheaprest to our Company.

Mowry's prices at time of last purchase from Whitney were about $1 per wheel higher.

Not sure how often have purchased Whitney's wheels: think twice, several years ago—seven or eight years ago—and none since.

No inducements held out by Mowry except same guarantees as other makers.

No inducements held out to us by Mowry to buy from him, except same guarantees as other makers; any wheel proving deficient within twelve months, he would replace at his own cost. No abatement in price by reason of cost of transportation of other wheels. He did claim peculiar advantages for his wheel.

Do not know the Murphy process, nor of Mowry's present process, that is, if he has changed from his charcoal process. Believe slow cooling an advantage; do not consider slow cooling annealing.

Wheels wear unevenly by improper application of brakes, sliding, &c.

Mowry's sales not increased by reason of his patented process.

I think Mowry, had he been manufacturing an unannealed wheel, would have been able to compete with Mr. Whitney, as far as our roads are concerned; he sold us no greater number of wheels, because he was making annealed wheels. I really don't think he sold us as many.

Richard Bromley.

Rec., pp. 215-222.

Residence Hamilton County, Ohio; Superintendent Machinery Little Miami, and Columbus and Xenia Railroad.

Has experience with wheels made by Whitney's and Mowry's processes; also for eighteen or twenty years with wheels annealed or cooled in the ordinary manner.

Annealed (re-heated) wheels no greater commercial value than slow-cooled wheels.

There has been no difference in the commercial value of one kind over the other; have made purchases of both at same prices, at same time.

During past ten years should think about one-fourth the entire number of wheels used by us were re-heated wheels.

"In our first experience with annealed (re-heated) wheels, no difference was made in the price; after we became more acquainted with the annealed wheel we found the chill not as deep nor as uniform as the unannealed (slow-cooled) wheel, consequently not as durable. As to the price, there has been no difference. We discontinued the purchase of the annealed wheel.

Discontinued purchase of the re-heated wheels.

Cross-Examination.

Understand the "ordinary manner" of cooling car wheels as including all modes where no extraneous heat is required. We used wheels made from Mowry's own patterns and sizes, which were the same, whether annealed or unannealed.

Mowry's sizes and patterns were the same whether "annealed" or "unannealed."

The 33-inch narrow tread and double plate averaged about 520 pounds, wide tread; same size, about twenty to thirty pounds more. We use nearly all double-plate Washburn wheels. Mowry's wheel lost us more per wheel than Whitney's. Have no personal knowledge as to loss in melting and casting iron, but presume three per cent. would be a fair average.

The annealed wheel would probably resist a greater number of blows on the side than the unannealed, but for practical purposes, don't think any material difference in strength.

Purchased wheels from Mowry before 1861, but not from Whitney until after 1861.

Samuel First—Recalled.

Have invoiced iron on hand, in taking account of stock on 1st of January, each year, at the then market value. Rec., p. 227.

Mowry owns the right to manufacture the Washburn wheel. He also owns the Atwood Patent; also the Murphy Patent for cooling car wheels.

Has been my business to conduct the correspondence relating to Mowry's business; never sent to railroad companies a circular relative to his charcoal, respecting his charcoal process; do not know that such a circular has been sent. [Witness shown Circular Exhibit G, R, S —Circular]. I have seen that Circular, but do not know of its having been sent out.

Never sent out circular.

Samuel First—Re-Examined.

Have made up from the books complete and correct statement of the quantity of *cold blast iron* purchased by Mowry during the time he manufactured annealed car wheels. Rec., pp. 224.

(Produces statement—"Exhibit L. A. Green & Co."—showing purchase of 3054 tons, 1213, costing $179,062 59: being an average, with trasportation and drayage, of $60 63⅕ per ton.

Exhibit L. A Green & Co. Total purchases by Mowry of "cold-blast" iron, 3054 tons, costing $179,062,54.

Have also made statement of commissions paid on sales of wheels. Attaches same—marked "Exhibit C, M, N"—showing payment of $1,154 94—commissions.

MATERIAL—Cold Blast Iron for Car Wheels.

1861			1862			1863			1864			1865			1866			1867		
On hand Jan. 1st, Per Invoice.	Bought.	Price per Ton.	On hand Jan. 1st, Per Invoice.	Bought.	Price per Ton.	On hand Jan. 1st, Per Invoice.	Bought.	Price per Ton.	On hand Jan. 1st, Per Invoice.	Bought.	Price per Ton.	On hand Jan. 1st, Per Invoice.	Bought.	Price per Ton.	On hand Jan. 1st, Per Invoice.	Bought.	Price per Ton.	On hand Jan. 1st, Per Invoice.	Bought.	Price per Ton.
Tons.	Tons.	$	Tons.	Tons.	$	Tons.	Tons.	$	Tons.	Tons.	$	Tons.	Tons.	$	Tons.	Tons.	$	Tons.	Tons.	$
266½	.....	27.00	100	.....	26.00	152	.....	46.00	130	.....	60.00	355½	.....	80.00	100	.....	63.00	196	.....	60.50
.....	178	28.00	.....	2	25.00	.....	101	40.06	.....	91	49.00	.....	48	55.00	.....	69	62 50	47	.....	54.50
.....	2	25.00	.....	100	27.00	.....	192	45.00	.....	98	65.00	.....	21	54.00	.....	5	75.00	.....	.....	.....
.....	.....	.....	.....	40	30.00	.....	6	40.00	.....	150	60.00	.....	20	65.00	.....	50	55.00	.....	.....	.....
.....	.....	.....	.....	94	38.00	.....	111	45.00	.....	7	65.00	.....	4	62.00	.....	24	67.50	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	115	55.00	.....	180	65.00	.....	22	62.00	.....	2	67.30	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	9	65.00	.....	26	65.00	.....	97	65.00	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	5	77.50	.....	.....	.....	.....	5	65.00	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	10	85.00	.....	.....	.....	.....	205	61.50	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	57	70.00	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	102	77.50	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	5	83.00	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	107	79 50	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	150	75.00	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	50	80.00	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	100	73.00	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	50	73.00	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	50	80.00	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	25	80.00	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	10	80.00	.....	.....	.....	.....	.....	.....	.....	.....	.....
266¼	180	.....	100	236	.....	152	525	.....	130	1256	.....	355½	141	.....	100	457	.....	243	.....	.....

LABOR.

Wages Paid 9 hands (making 8 Wheels per day) in each year.

YEAR.	One Hand at	One Hand at	One Hand at	Six Hands at	Total cost of Labor for 8 wheels per day.
1861.....	$2 25	$1 75	$1 25	$6 50	$11 75
1862.....	2 25	1 75	1 25	6 50	11 75
1863.....	2 25	1 75	1 25	7 00	12 25
Oct., Nov., Dec.....	2 25	1 75	1 50	9 00	14 50
1864.....	2 71	2 71	2 00	10 00	17 42
1865.....	3 75	2 71	2 50	11 18	20 14
1866.....	3 50	2 71	2 25	11 00	19 46
1867.....	3 75	2 71	2 25	11 00	19 71

State Taxes paid on Foundry, chargeable to wheel account, being three-fourths of total Taxes paid.

1861.....	$230 52
1862.....	217 41
1863.....	409 23
1864.....	871 86
1865.....	513 35
1866.....	310 23

Water Rates paid, chargeable to wheel account, being two-thirds of entire amount paid.

1861.....	$40 00	⅔.....	$26 67
1862.....	40 00	⅔.....	26 67
1863.....	48 00	⅔.....	32 00
1864.....	80 00	⅔.....	53 34
1865.....	80 00	⅔.....	53 34
1866.....	80 00	⅔.....	53 34

CHARCOAL, COKE, SAND AND FLOUR.

	Per 100 Wheels.	Per Wheel.
Charcoal		.15
Sand (Moulding)	$24 00	.24
Sand (Sharp)	5 00	.5
Flour	15 00	.15
Coke	58 00	.58
Average cost (in 1861-2-3-4-5-6 & 7)		$1.17

Insurance paid on Foundry, chargeable to wheel account, being three-fourths of entire amount paid.

1861	$225 00
1862	225 00
1863	225 00
1864	225 00
1865	225 00
1866	225 00

Capital and Interest.

The ground, buildings, machinery, tools and fixtures occupied and used by A. L. Mowry in his car shop and foundry, are estimated at ***$135,000,*** of which ***$35,000*** is for stock or materials. Of this sum ($135,000) one-third is attributed to the car-wheel business—say: $45,000 at 6 per cent. gives $2700 per annum for interest on capital.

Wear and Tear, estimated on Foundry and appurtenances, $8,000, of which three-fourths is for wheel account.

1861,	9 months,	10 per cent. per year.....	$450 00
1862,	"	"	600 00
1863,	"	"	600 00
1864,	"	"	600 00
1865,	"	"	600 00
1866,	"	"	600 00
1867,	3 Months,	"	150 00

Salaries paid FIRST & GREEN so far as chargeable to wheel account.

1861.....	$337 50	$675 00	$1012 50	9 mos.
1862.....	450 00	900 00	1350 00	per an,
1863.....	450 00	900 00	1350 00	per an.
1864.....	500 00	900 00	1400 00	per an.
1865.....	600 00	900 00	1500 00	per an.
1866.....	700 00	900 00	1600 00	per an.
1867.....	175 00	225 00	400 00	3 mos.

Drayages.

Paid on Iron.....	$2 00 per Ton.
" " Wheels.....	2 00 " "

GOVERNMENT TAXES PAID ON "CASTINGS."

MONTH.	1863			1864			1865			1866			1867			LICENSE.
	TONS.	PER TON.	AMOUNT.	TONS.	PER TON.	AMOUNT.	TONS.	PER TON.	AMOUNT.	TONS.	PER TON.	AMOUNT.	TONS.	PER TON.	AMOUNT.	¾ OF TAX.
January	.....	.....	.....	56⅜	$1 50	$84 63	75½	$3 00	$226 50	83	$3 60	$298 80	95½	$3 00	$286 50	1863-4-5-6-7, five years, at $7 50 per year.....$37 50
February	.....	.....	.....	78	1 50	117 00	37	3 00	111 00	155	3 60	558 00	38	3 00	114 00	
March	.....	.....	.....	46¾	3 00	140 25	33	3 00	99 00	45½	3 60	163 80	89½	3 00	268 50	
April	.....	.....	.....	155	3 00	465 00	48	3 60	172 80	20¾	3 60	74 70	.....	.....	.....	
May	157½	3 00	472 58	53	3 00	159 00	36	3 60	129 60	67¼	3 60	242 10	.....	.....	.....	
June	.....	.....	.....	39¼	3 00	117 75	51	3 60	183 60	41¾	3 60	150 31	.....	.....	.....	
July	.....	.....	.....	149	3 00	420 00	123½	3 60	444 60	40¼	3 60	144 90	.....	.....	.....	
August	98⅜	1 50	148 25	77¼	3 00	231 75	41	3 60	147 60	62	3 00	186 00	.....	.....	.....	
September	51½	1 50	77 25	111	3 00	333 00	61	3 60	219 60	170	3 00	510 00	.....	.....	.....	
October	62¼	1 50	93 37	77	3 00	231 00	53	3 60	190 80	162	3 00	486 00	.....	.....	.....	
November	64	1 50	96 00	86	3 00	258 00	134	3 60	482 40	121	3 00	363 00	.....	.....	.....	
December	66½	1 50	99 75	229½	3 00	688 50	178	3 60	640 80	165	3 00	495 00	.....	.....	.....	
TOTAL	500¾	.....	$987 20	1150⅜	.....	$325 88	871	.....	$3,048 30	1133½	.....	$3,672 61	223	.....	$669 00	

SUMMARY OF ABOVE TABLE

YEAR.	TONS.	TAXES.
1863	500½	$ 987 20
1864	1150½	3245 88
1865	871	3048 30
1866	1133½	3672 61
1867	223	669 00
TOTAL.,.....	3878½	$11,622 99
LICENSE.....	.....	37 50
		$11,660 49

Commissions paid from 1861 to 1867—April to April—*estimated* by FIRST, at say,.....

Bad Debts and Discount on Bills.

Jan , 1865—Paid discount on Quartermaster's Vouchers.....$12

1864—Fulton Manufacturing and Coal Mining Co., Wheels and Axles

1867—February—L. A. Danby, Wheels and Axles.....

And in answer to questions respecting the above car wheels, nor FIRST says that the discount on quartermaster's vouche he use of such amount of a contract made by MR. MOWRY with the G 304 railroad cars; the amount of vouchers received by the Master in ment of said contract was $106,695 25, which he disco ble to discover cent., making the above amount of $12,803 43. These ss; that it was plied with 8 wheels each (33-inch single plate), or 2,4 nealed wheels; to the two items of $521 81 and $536, he says they are eferred the old MR. MOWRY for wheels and axles. The one of $521 8 ss used by the be bad, but it was for coal-car wheels that were not an er the new an- one for $536 he considers doubtful. e process com-

And he says that he should estimate the axles to repre since the De- of said two accounts.

GOVERNMENT TAXES PAID ON "CASTINGS."

MONTH.	1863			1864			1865			1866			1867			LICENSE.
	TONS.	PER TON.	AMOUNT.	TONS.	PER TON.	AMOUNT.	TONS.	PER TON.	AMOUNT.	TONS.	PER TON.	AMOUNT.	TONS.	PER TON.	AMOUNT.	¾ OF TAX.
January	.....	.....	.....	56⅝	$1 50	$84 63	75½	$3 00	$226 50	83	$3 60	$298 80	95½	$3 00	$286 50	1863-4-5-6-7, five years, at $7 50 per year.....$37 50
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May	157½	3 00	472 58	53	3 00	159 00	36	3 60	129 60	67¼	3 60	242 10	.....	.....	.....	
June	.....	.....	.....	39¼	3 00	117 75	51	3 60	183 60	41¾	3 60	150 31	.....	.....	.....	
July	.....	.....	.....	149	3 00	420 00	123½	3 60	444 60	40¼	3 60	144 90	.....	.....	.....	
August	98⅝	1 50	148 25	77¼	3 00	231 75	41	3 60	147 60	62	3 00	186 00	.....	.....	.....	
September	51½	1 50	77 25	111	3 00	333 00	61	3 60	219 60	170	3 00	510 00	.....	.....	.....	
October	62¼	1 50	93 37	77	3 00	231 00	53	3 60	190 80	162	3 00	486 00	.....	.....	.....	
November	64	1 50	96 00	86	3 00	258 00	134	3 60	482 40	121	3 00	363 00	.....	.....	.....	
December	66½	1 50	99 75	229½	3 00	688 50	178	3 60	640 80	165	3 00	495 00	.....	.....	.....	
TOTAL	500¾	.....	$987 20	1150⅝	.....	$325 88	871	.....	$3,048 30	1133½	.....	$3,672 61	223	.....	$669 00	

SUMMARY OF ABOVE TABLE.

YEAR.	TONS.	TAXES.
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1866	1133½	3672 61
1867	223	669 00
TOTAL,.....	3878½	$11,622 99
LICENSE.....	.....	37 50
		$11,660 49

Commissions paid from 1861 to 1867—April to April—*estimated* by FIRST, at say,.....$600 000

Bad Debts and Discount on Bills.

Jan , 1865—Paid discount on Quartermaster's Vouchers.....	$12,803 43
1864—Fulton Manufacturing and Coal Mining Co., Wheels and Axles	521 81
1867—February—L. A. Danby, Wheels and Axles.....	536 00

And in answer to questions respecting the above items, SAMUEL FIRST says that the discount on quartermaster's vouchers was on the amount of a contract made by MR. MOWRY with the Government for 304 railroad cars; the amount of vouchers received by him in settlement of said contract was $106,695 25, which he discounted at 12 per cent., making the above amount of $12,803 43. These cars were supplied with 8 wheels each (33-inch single plate), or 2,432 wheels. As to the two items of $521 81 and $536, he says they are accounts due MR. MOWRY for wheels and axles. The one of $521 81 he believes to be bad, but it was for coal-car wheels that were not annealed, and the one for $536 he considers doubtful.

And he says that he should estimate the axles to represent ⅓ of each of said two accounts.

A ton of iron is 2268 pounds.

The old wheels bought for and used in making new wheels cost about as much as new iron, considering the loss; the old wheels were used for no other purpose than the making of new wheels.

Noyes G. Green.

Rec, p. 238.

The loss in melting and casting is ten per cent.; that is, a ton of iron 2268 pounds, gives 2041 pounds of car wheels.

Samuel First—Recalled by Master.

Rec, pp. 238-241.

On careful reflection think 12½ per cent. as proper allowance for loss in melting and re-casting old wheels.

Think about $\frac{1}{6}$th of the wheels made by Mr. Mowry were single-plate wheels.

Presents statement of "*old car wheels*" purchased and used by Mr. Mowry from April, 1861, to February, 1867, amounting to $80,313 45, and says:

"A. I have prepared it. It is a complete abstract from the books of A. L. Mowry—that is, from the day book—of all the entries of old wheels purchased between the 1st of April, 1861, and the 12th of April, 1867, and used in the manufacture of car wheels. It includes, also, old tires purchased, and thus shows, so far as appears from Mr. Mowry's books, all the old iron purchased and used in the manufacture of car wheels, and the cost of the same. The books, however, do not show all the old wheels purchased, for the reason that sometimes Mr. Mowry would settle with the parties from whom purchases were made, at his office, down in the city, and return to me only a statement of the amount to be credited to those parties.

"Q. 2. How much would it be right to allow for those settlements, at a liberal estimate?

"A. Those settlements were all prior to 1864. Since the 1st of January, 1864, he has rendered to me full accounts, and the abstract shows the entire purchases. For the years 1861, 1862 and 1863 I should say there ought to be allowed six hundred wheels in addition to what is shown by the books, weighing, say one hundred and fifty tons. I would say one hundred wheels for 1861, two hundred for 1862, and three hundred for 1863; that is, twenty-five tons for 1861, fifty tons for 1862, and seventy-five tons for 1863; that, I think, will cover it.

"Q. 3. At what prices should these estimated purchases be computed?

"A. At the same rates per pound as shown by the abstract for the same period.

"A. 4. Was all this old iron used in the manufacture of annealed car wheels? If not, how much of it was used for other purposes?

"A. As far as I know, it was all used for car wheels and chilled tires—the chilled tires amounting only to four or five tons per year, as I have before stated.

"Q. 5. What quantity of old wheels did you have on hand at the date of the injunction?

"A. I think we had a few, but not many; I do not remember how many.

"Q. 6. Now, if we add to the cold blast iron purchased and used for the manufacture of annealed car wheels, the old wheels and old tires referred to in your testimony above, and the abstract, will that make up the total of iron used in the manufacture of annealed car wheels by Mr. Mowry?

"A. Yes, sir, I think it will.

"Q. 7. Was any of this material used in the manufacture of unannealed car wheels? If so, how much and when?

"A. It was all used in the manufacture of annealed wheels, except the two lots of unannealed wheels sold to Mr. Wessel August 22, 1863, and September 1, 1863, as heretofore stated by me.

"Q. 8. Did you use up during each year all the old wheels purchased in that year?

"A. Never, except one year, when we cleaned them out within four or five. One year—I think, 1864—we had quite a number left over. The invoices show that we had each year old iron on hand, in which was included old wheels, but they were not designated as to quantity or weight.

"SAMUEL FIRST."

United States Circuit Court,

SOUTHERN DISTRICT OF OHIO.

BEFORE GEORGE R. SAGE, ESQ., MASTER.

ASA WHITNEY
vs.
A. L. MOWRY.

It is hereby agreed that the following statement is admitted as part of the deposition of Noyes G. Green before the Master, and as part of the stipulation in this behalf, dated "Cincinnati, May 15, 1868."

"Noyes G. Green says that the loss in melting and casting iron is ten per cent.: that is, a ton of iron 2268 pounds gives 2041 pounds of car wheels.

Said statement to be deemed and taken as in evidence before the Master as of the date of said stipulation.

It is further agreed that the case before the Master, so far as the taking of testimony is concerned, is now closed, and that the report shall, if then filed, be considered by the Court as early in October next as possible.

HENRY BALDWIN, JR.,
For Compl't.

Phila., July 15, 1868.

CHARLES B. COLLIER,
For Def't.

Pages 239–259 of the printed record of the case embrace the figures and calculations on which the "Report" of the Special Master, that follows, is based: no abbreviation of said figures can be made.

THE SPECIAL MASTER'S REPORT.

Rec., pp. 259-261. Finds, 1. That Mowry began the use of the process complained of, April, 1861, and continued it to April 7, 1867: that during said time he made and sold 19,819 wheels, which cost $331,327 64, and the gross receipts therefrom were $412,829 50.

That the profits realized on said sales of 19,819 wheels were $81,505 86, and the interest on said profits, from the time of their accruing—that is, from the first day of the month next ensuing the sales, to the first of August, 1868—amounts to $18,860 38, making a total of $100,362 24 of profits.

"11. That on account of the charcoal and extra labor, the cost of the annealed wheels so manufactured was, on the average, twenty-five cents per wheel more than the cost of the same wheels without the use of the charcoal, or the re-heating process would have been; and that no addition was made to the price of wheels on account of their having been manufactured by said process of re-heating."

The Master herewith submits the schedules and exhibits showing the computations by which he arrived at the results stated in Finding No. 1, above.

(Signed)

GEORGE R. SAGE,
Special Master.

Dated *Cincinnati, Aug.* 1, 1868.

SUPPLEMENTARY REPORT OF THE SPECIAL MASTER,

Rec., pp. 261-264. States that he has discovered certain errors in his computations, and corrects the same, the result being a profit of $91,501 86, and interest $19,984 21; total, $111,486 07.

Further reports:

"1st. That the Defendant, prior to the first of April, 1861, and without the use of the process complained of in this cause, had built up his business to its then condition.

"2d. That the use of the process complained of in this cause did not diminish, but did increase the cost of making the wheels manufactured by the Defendant, as set forth in Finding No. 2, in the original report herein.

"3d. That the 19,819 wheels manufactured and sold by the Defendant, by the use of the process complained of in this cause, had they been manufactured by the use of the process adopted by the Defendant prior and up to April, 1861, and been sold at the prices which they actually did bring, would have yielded the Defendant a profit of $4,754.75 greater than the profit he did in fact realize from the manufacture and sale of said wheels.

"4th. That the Defendant did not, when he began the use of said process, nor afterwards, while he continued its use, make any difference in the quality of iron used for the manufacture of car wheels, nor in the weight or form of car wheels, nor by reason of the use of such process, in their price.

"5th. That the Defendant was unable to discover that his business was increased by the use of said process; that it was with a great deal of difficulty that he introduced the annealed wheels; that the railroad companies purchasing from Defendant preferred the old wheels — that is to say, those manufactured by the Defendant prior to April, 1861— for one or two years after the new annealed wheels — that is to say, the wheels annealed by the process complained of in this cause — were first introduced, and that since the Defendant has been enjoined in this cause, and has abandoned the use of the process complained of, he has had the same customers, (excepting the Little Miami and the Columbus and Xenia Railroad Companies, and it does not appear that said companies have withdrawn their custom on account of said abandonment), and has sold the wheels he has since manufactured without the process complained of, as readily as those manufactured by use of said process, and at the same *prices*.

"6th. That during nine months preceding June, 1868, the Defendant has been operating his foundry every other day only, and manufacturing from eight to twelve wheels for each day the foundry was operated; and that in the years 1866 and 1867, he operated his foundry full time one-fourth of the year, and half time the rest of the year.

"7th. That since the Defendant abandoned said process complained of, he has manufactured a wheel called the Washburn wheel, more properly called the Atwood wheel, not exactly after Washburn's Patent, but in a modified form — the same in form as before and during the infringement — using pits made of iron, sunk in the ground — taking the wheels from the mould at the same degree of heat as in the process complained of in this cause, placing them in the pits without any fuel, covering the pits up, leaving the wheels in four or five days; then taking them from the pits, and allowing them to cool in the open air.

"8th. That the Defendant, in the manufacture of the 20,242 wheels referred to in Finding No. 1 of the original report herein, used no process for annealing or slow cooling, excepting that complained of in this cause, and that that process was applied to the castings bearing the shape of car wheels; and by its application to said castings, said 20,242 car wheels were made, and rendered fit for the market and for use.

"9th. That in 1849, the Complainant granted a license under his said Patent, at a royalty of one doller per wheel; a few wheels were made by the licensees thereunder, and paid for at that rate, when the license was revoked and cancelled.

"That in 1851, the Complainant granted a license to another party, but no wheels were made under it, and it was very soon revoked and cancelled.

"That in 1847, the Complainant started the business of manufacturing car wheels by said process, in company with his son, George Whitney, under the firm-name of A. Whitney & Son; said George Whitney having one-third interest in said business.

"That from 1850 to 1861, both inclusive, said Complainant continued said business with his sons, and under the firm-name of A. Whitney & Sons; the firm paying said Complainant one dollar per wheel aside from his proportion of the profits; said sum of one dollar per wheel being charged to the expense account of the business.

"That since 1861, said firm of A. Whitney & Sons have continued said business; the Complainant putting in his Patent without charging the royalty theretofore paid, and the firm paying the expenses of the extension of said Patent in 1862.

"That otherwise than, and save as aforesaid, the Complainant has kept the right under his said Patent exclusively and solely for his own use and enjoyment; uniformly declining and refusing numerous applications for licenses, and preferring to supply the demand for wheels from his own Works, which he has enlarged from time to time, so that he has been able to supply such demand.

"That from 1847 to July 1st, 1866, said firms of A. Whitney & Son and A. Whitney & Sons, made by said patented process 464,475 wheels.

"All of which is respectfully submitted.

"GEORGE R. SAGE,
"*Special Master.*

"CINCINNATI, *September* 17, 1868."

EXCEPTIONS TO MASTER'S REPORTS ON BEHALF OF DEFENDANT MOWRY.

1. To first branch of report.

Rec., pp. 265-268

First. It is not complete; the Master has stopped short of the ultimate inquiry. He has found the total profits derived by the Defendant from the manufacture and sale of 19,819 wheels, in the making of which the Complainant's improvement was employed, but has made no apportionment of such profits.

Second. If the Master, in that branch of his report under consideration, intends to report $91,501 86 as the amount of profit realized and made by the Defendant, by reason of the application by him to said 19,819 wheels of the Complainant's improvement, then is the objection urged that such finding is contrary to and unsupported by the testimony.

Third. This branch of the report is objected to, for the further reason that the cost of said wheels is not correctly stated.

(The error being in understating the quantity of iron used, and in taking no account for loss in process of melting and casting. The result being an under-statement of cost of about $45,000.)

Fourth. The testimony discloses that the Defendant had obtained Letters Patent, under which he annealed and cooled his car wheels; that he was also a licensee under the Washburn, Atwood and Murphy Patents, and had employed the improvements secured by said Patents, or some of them, in making said wheels.

This, the first branch of the report, is objected to for the further reason that no apportionment of profits has been made between the Complainant and the other improvements used by the Defendant.

Fifth. The Defendant objects to all that part of the report which relates to interest: first, because the Complainant is not entitled to interest; second, because the interest is calculated upon the entire profits of Defendant's car-wheel business; third, because such profits, and consequently the interest, are erroneously stated.

United States Circuit Court,

SOUTHERN DISTRICT OF OHIO.

ASA WHITNEY *vs.* ALBERT L. MOWRY. } Exceptions to the Draft Supplemental Report of GEORGE R. SAGE, Esq., Special Master in said cause.

Complainant's Counsel respectfully submits the following Exceptions to said Supplemental Report, dated September 17th, 1868:

First Exception.—The evidence does not warrant the Master in finding as matter of fact, "that the Defendant did not, when he began the use of said process, nor afterwards while he continued its use, make any difference in the quality of iron used for the manufacture of car wheels, nor in the weight or form of car wheels, nor, by reason of the use of such process, in their price."

Second Exception.—The evidence does not warrant the Master in finding, as matter of fact, "that the Defendant was unable to discover that his business was increased by the use of said process; that it was with a great deal of difficulty that he introduced the annealed wheels; that the railroad companies purchasing from Defendant preferred the old wheels—that is to say, those manufactured by the process used by the Defendant prior to April, 1861, for one or two years after the new annealed wheels—that is to say, the wheels annealed by the process complained of in this cause—were first introduced; and that since the De-

fendant has been enjoined in this cause, and has abandoned the use of the process complained of, he has had the same customers (excepting the Little Miami and the Columbus and Xenia Railroad Companies, and it does not appear that said companies have withdrawn their custom on account of said abandonment), and has sold the wheels he has since manufactured without the process complained of, as readily as those manufactured by the use of said process, and at the same prices."

HENRY BALDWIN, JR.,
Complainant's Att'y.

October 2d, 1868.

ADDITIONAL REPORT OF MASTER.

* * * * * * *

"That prior to the time of the adoption by the Defendant of the Complainant's improvement, he, Defendant, prolonged the time of cooling his wheels by placing them in pits covered with dry sand, in some cases using air-tight pits without any sand; placing the wheels in the pits, and allowing them to remain there four or five days; that by reason of such treatment they were finished and made ready for the market, and without further treatment were sold."

Cincinnati, October 7th, 1868.

United States Circuit Court,

SOUTHERN DISTRICT OF OHIO.

ASA WHITNEY,
vs.
A. L. MOWRY. } 534.

OCTOBER 21, 1868.

Before Justices Swayne & Leavitt, upon the Exceptions of the Complainant and Defendant to the Reports of the Special Master.

OPINION OF THE COURT, AS DELIVERED BY JUSTICE SWAYNE.

The only question before us, as the case has been presented in the arguments just closed, is whether by the Master's Report, as it stands,

the Plaintiff is entitled to the entire amount of profits which have been made by the Defendants as estimated. If that be clear, we need no further light on the subject, and there is no necessity for referring the matter back to the Master for a further report, and for him to take further testimony in the case, leading to the proper solution of this point.

The claim of the Patent is as follows: "I do not claim to be the inventor of annealing castings made of iron, or other metal, when done in the ordinary way." That ordinary way is well understood in the history of the arts, and need not be remarked upon. "Nor do I claim to be the inventor of any particular form or kind of furnace in which to perform the process." There is here a clear implication and recognition of the right of others, notwithstanding the Patent of the Plaintiff, to perform this annealing process in the ordinary way, by means of a furnace used for that purpose.

"But what I do claim as my invention, and desire to secure by Letters Patent, is the process of prolonging the time of cooling, in connection with annealing railroad wheels in the manner above described--that is to say, the taking them from the moulds in which they are cast before they have become so much cooled as to produce such inherent strain on any part as to impair its ultimate strength, and immediately after being thus taken from the moulds, depositing them in a previously heated furnace or chamber, so constructed, of such materials, and subject to such control, that the temperature of all parts of the wheels deposited therein, may be raised to the same point (say a little below that at which fusion commences), when they are allowed to cool so fast, and no faster, than is necessary for every part of each wheel to cool and shrink simultaneously together, and no one part before another."

Here, it will be observed, in relation to this claim, that two things are claimed, and everything else is disclaimed:

First, the re-heating of the wheel to be annealed, and that re-heating in connection with the slow-cooling process, which slow-cooling process was known before in the history of the arts.

The re-heating is that which is claimed to be new, and which this Court has found, theretofore, to be new; this combination of the re-heating with the old thing—the slow cooling of the wheel.

Now pursuing this line of thought and analysis, we find that railroad wheels are to be made of the same dimensions as before; they are to be of the same configuration as before; they are to be made of fused metal as before; the metal is of the same kind as before; it is to be fused in the same manner as before; it is to be introduced into the proper moulds in the same manner as before; the wheel is to be com-

pleted—aside from the annealing process—in the same manner as before; it is to be taken from the moulds in the same manner as before.

Up to this point the process of the patentee towards the accomplishment of the ultimate result is just the same as would be pursued if the Plaintiff's process had never been invented.

Here the roads fork and the divergence commences. Now any person, irrespective of this Patent, after the wheel has reached the point mentioned, would have the right, in consistency with this Patent, immediately to put it into a pit — the right would exist, as I understand is conceded, to apply hot sand, sand previously heated — the right would exist to close the pit and exclude the air, and to subject the metal to the annealing process by slow cooling, as the phrase is, to such extent as this means, or any other means known in the history and practised in the art of annealing prior to that time, might suggest. The Plaintiff, then availing himself of all these means and instrumentalities, interposes, in the progress of the construction and completion of the wheel, a new element, the right to use which exclusively is secured to him; and that new element is simply, after the wheel has been taken from the mould and has been placed in the pit, to subject it to a re-heating — a tempering which involves the re-heating of the iron structure; and then that re-heating is to be connected with the old process of slow cooling. In this re-heating, in combination with slow cooling, lies the novelty, the utility, the vitality of this Patent.

Viewing this subject in this light, it does not seem to us that there is anything in the case — any fact or feature which should take it up from the rule laid down by the Supreme Court — and which stands unshaken — in the case of Seymour *vs.* McCormick, 16 Howard.

Now I have referred to this extent upon the case as presented, irrespective of one element, to which I am now about to address myself, and in reference to which I submitted to Counsel who argued this question one or two inquiries, the answers to which then seemed to me, and still seem to me, to be very material, and which I understand are not answered by the report of the Master.

There is proof in the case that car wheels, annealed in modes known in the history and application of the art, otherwise than by the mode involved in the invention of the Plaintiff, have a market value—that they have been sold and used—that they are still sold and used. But upon this subject the proof is not clear or full, nor by any means conclusive. Nor has the Master categorically reported upon this particular point.

All this is preliminary, as it regards this view of the subject and this

proposition. If the proof were, that when the wheels were made up to that point—when they are to be subjected to some annealing process—if the proof were that the wheel, at that point, was worthless — had no actual or market value —was worth nothing to the maker, and could not be of any value to him until subjected to the process covered by the Plaintiff's Patent, then, perhaps, and I use that word upon reflection; then, perhaps, it might be said that if the wheel had no value before being annealed according to the process of the Plaintiff, and after being so annealed its value involved a particular amount of profit, more or less; perhaps it might be said the entire amount of profit made by the manufacture of the wheel was due to the process of the Plaintiff, and that, therefore, would be the standard and measure for the recovery of damages.

Now the Master, as I understand, has not presented the case in this aspect. Irrespective of this particular aspect we have no hesitation in saying that this is a case proper for the apportionment of damages.

But it seems to us that it might as well be claimed that the Plaintiff was entitled to the entire profit of the running gear, other than the wheel, or upon the entire car, involving the running gear, as well as the body of the car, as the entire profit made upon this wheel.

The Master has not reported on this subject; and here it seems there is clearly wanting an element to enable us to arrive at a proper conclusion on this particular point; and as it may possibly come before us hereafter, on the report of the Master, I wish here to make one or two additional suggestions. So far as I know, this question is a new one, and I have as yet been unable to come to any conclusion on the subject entirely satisfactory to my own mind. But it would seem to be very clear that if a party invent a machine, or anything else that is perfectly valueless, having no saleable commercial value, and in every other respect is worthless because he cannot sell it; and then use in connection with that machine, or structure, or article, whatever it may be, the invention of another, no matter how slight that invention may be, which gives it its entire market value, it would seem, at first view, that the amount to be recovered should be the entire amount of profit, because there is a proximate, inseparable connection between the old or useless article sold by means of the new invention which could not have been sold otherwise. In the case of a close monopoly, there is a profit made which would seem, at first view, is entirely due to the infringement of the Patent-right of another; and it would seem that the infringer ought not to be permitted to say, under such circumstances, that there should be an apportionment of the profits. But, on the other

hand, take the case, for instance, of a railroad car, or anything else, the making of which involves a large expenditure of money; and then by the application of the invention of another, slight and trifling in its character—of very little cost—of no value, except in connection with that structure, the application of that slight improvement is sufficient to turn the scale in the market, so that nobody will buy the article except in connection with the patented invention. Suppose, in further illustration of this view of the subject, it be a railroad car, the cost of which is thousands of dollars, and some little invention is made in regard to the interior structure of the car, or in its ornamentation, which is patentable under the act of 1861; yet the slight, the simple thing, is such as to strike the public taste and judgment, and have such an effect in the commercial world that nobody will buy the article without that invention; yet it would seem to be a pretty hard measure of justice in a Court of Equity, to say that the entire profits made on that large article should go into the pockets of the inventor and patentee of this small thing, which had been used without license or authority in connection with it.

I therefore have to remark, as it regards this particular question, we intend to leave the case open. The case must go back to the Master for a fuller report upon the general subject, which was adverted to this morning, and discussed this afternoon, in connection with damages, and to which the Court has adverted just now. The question must go to the Master to take testimony, and report what portion of the profits made by the Defendant are due to the use of the invention of the Plaintiff by him without authority; and it may be said further, that this general inquiry would involve a further element relating to the subject. The inquiry may be more specific, to the extent of requiring the Master to take testimony, and report whether the wheels were not worth something, without the use of this invention, whether they could have been sold at all—if he finds they could not, then the question to which I have adverted will come before the Court for consideration. If he finds there is a sale for wheels not covered by this Patent—if he finds the wheels could have been made marketable and saleable, though not so saleable as if the process of the Plaintiff had been used, then he will have to inquire what portion of the profits which the Defendant realized is due to the use of the process covered by the Plaintiff's Patent.

With the case before us in this single aspect we shall then be prepared to dispose of this question; until then, we feel that the question is not ready for us, we shall terminate the argument, and refer the case back to the Master, in conformity with the directions just submitted.

Mr. Stanton.—Your Honor has heard argument on but one side.

The Defendant has not yet been heard on any proposition, except that the report was not sufficient. I suppose I am right in assuming that those points, so clearly stated by your Honor, for the purpose of inquiry by the Master, will be open for discussion before the Court when the Master's report again comes in. At that time, I expect to be able to show that the case is not one for apportionment, that it is not one for damages in any respect whatever; and that the Plaintiff, by having this prohibitory order, has obtained all the relief which, supposing his Patent to be valid, he is justly entitled to, under the Patent law, as administered in the United States; but as the case has very properly gone over for further light, I desire now simply to inquire whether I am right in assuming that these questions are open, and that the mind of the Court is open for judgment upon any point affected by what the Master may hereafter report.

Judge Swayne.—You are right in that view of the subject. We intended to decide nothing, except upon the point that the report must be recommitted to the Master, for the taking of further testimony, and for a further report upon these specific points. We do not decide the question as to any amount of profits; neither that we will not give him the total profits, nor that there shall be any apportionment of profits; nor that the Plaintiff, when the Master's report again comes in, will be entitled to any damages.

Mr. Stanton.—Will your Honor prepare an order?

Judge Swayne.—I prefer that Counsel should do it.

In the administration of justice in this class of cases, I have found it a saving of time and expense, besides giving specific instructions to the Master, to direct that he take testimony and report upon any other subject according to the direction of Counsel in the case on either side.

Mr. Stanton.—There may be some objections to that in this case. I would make no imputation against the Master; he may be fair and honest; I don't know him; and yet I do not think, in view of the magnitude of the interests that may be affected, that it is safe to have many communications between Counsel and Master, except what goes upon record, and transpires in the presence of Counsel on both sides.

Judge Swayne.—The suggestion was made only for the convenience of Counsel. Of course, whatever occurs with the Master will be under the supervision of Counsel on both sides.

Mr. Fisher.—If either Counsel desires testimony on any point not named by the Court, it would seem to be proper that these special inquiries be made by the Master in connection with Counsel, and not privately.

Mr. Stanton.—I go further, and submit that the request be made; that the Court be requested to order such examination to be made, if it sees proper.

Judge Swayne.—Counsel can either give the Master, in the order now to be entered, specific instructions as to points upon which testimony is to be taken, or they may go further, and say that he shall take such further testimony, and report upon the same, as Counsel on either side desire, but it does not occur to me that it will be necessary for the Master to go beyond the sphere of the suggestions made from the bench.

Mr. Stanton.—I suggest that he pause at the point indicated by the Court; because I can see no good result in the way of arriving at the ends of justice by reopening the general matters of fact.

Mr. Fisher.—I agree with Mr. Stanton entirely.

Mr. Collier.—Propositions which either party may desire to have passed upon, may be submitted.

Judge Swayne.—As my associate on the bench, who heard the case originally, suggests that we do not mean to throw the rein loose on the neck of the Master, and let him go where he chooses. We do not want him to go over ground on which he has already gone. The testimony to be sought is additional to the testimony already taken, and on a point not already reported upon.

United States Circuit Court,

ENTERED OCTOBER 22, 1868.

ASA WHITNEY
vs.
ALBERT L. MOWRY. } 534.

This cause came on to be heard upon the reports of the Master, and the exceptions thereto, and was argued by the Counsel of the respective parties, whereupon it is ordered by the Court that the said Master take further testimony, and report to the Court what proportion, if any, of the profit made by the said Defendant, was due to the use by him of the Complainant's invention, and that in connection with this subject, the report:

First. Whether the wheels made and sold by the Defendant had, or could have been made to have, any market value without being subjected to the process patented to the Complainant.

Second. If they had, or could have been made to have, such value, by any annealing, or slow-cooling process, outside of the Complainant's Patent, how much additional and greater market value, if any, they derived from being subjected to said patented process.

It is further ordered that said testimony shall be taken within sixty days from the time of the entry of this order, that the said Master shall file his report within forty days thereafter, and that either party may file exceptions within thirty days thereafter, and this cause is continued.

TESTIMONY ON BEHALF OF DEFENDANT, TAKEN PURSUANT TO ORDER OF RE-COMMITMENT—ENTERED OCT. 22, 1868.

William Cullen.

Master Mechanic Cincinnati, Hamilton and Dayton, and Dayton and Michigan Railroads.

Have charge of all the rolling stock belonging to the roads.

We bought wheels from Mowry prior to 1861; we bought from him when I commenced, 1853, with the roads; have also bought from him wheels made by his charcoal process, since 1861; have also bought from him since 1867, and are now buying from him.

There has been no change in the form or weight of his wheels that I have known of, nor any difference in the market value of the charcoal-treated wheels as compared with the others.

Jerry O'Donnell.

Book-keeper for John Nash, Manufacturer of Car Wheels.

Testifies to use of charcoal process prior to April, 1868, and to ceasing it and present use of slow cooling alone, and that the slow-cooled wheels command prices equal to the charcoal-treated wheels, and are equally saleable.

* * * * * * * *

Wheels, if not subjected to any process of annealing or slow cooling, would be of no account.

James Lamb.

Purchasing and Supply Agent Little Miami Railroad.

Have purchased both kinds of wheels, annealed and unannealed; at one time, June, '66, could have bought the annealed wheels here at $22, and bought the other kind in Cleveland at $23 50; we had a good deal of trouble with the annealed wheels at time we made the change.

Have made no purchases from Whitney & Sons, but have had some experience in using their wheels. Some of the Whitney wheels on our road were as good as we ever used, and others about as bad; they would break in being pressed on the axles. These facts led me tothink that more depends on the quality of material used than on the process.

Wm. Clough.

Have manufactured car wheels at Madison, Ia., commencing in 1851. (Being asked how they were annealed, if at all, the witness says:)

"At first, by being covered with a mass of dry sand, and left on the foundry floor until the heat had slowly escaped. Afterward the wheels were annealed by being put into pits and covered with dry sand, a current of cold air being caused to circulate through the eyes of the hubs, to accelerate the cooling of the heavy mass of metal composing the hub. The effect in both cases was to equalize or accommodate the contraction of the metal in cooling, and prevent the occurrence of an inherent strain, which, if allowed, would impair the usefulness of the wheel. I have made for my use some thousands of car wheels. They were good wheels. I have always given them the preference over wheels annealed by other processes employed at the time * * * * The market value never, in my experience, was understood to turn upon, or be changed by, the peculiar process of annealing. Manufacturers commended their wheels by alleged advantages obtained by their peculiar process of annealing, but their prices did not vary with reference to said process of annealing. They did vary with regard to weight and pattern.

Alvin A. Stone.

Master Mechanic Little Miami Railroad: have been connected with Hartford and New Haven and Springfield roads from '49 to '55, and from '55 to '64 on the Milwaukee and Chicago; from June '64, to July '68, on the Marietta and Cincinnati.

Testifies to use of the Whitney wheel on the Hartford road in '51 and '52, and his unfavorable opinion of it, and that since then has not ordered any wheels from Whitney.

"Q. 6. Have you, during said period, seen other cast-iron car wheels, cooled by

being covered in pits or with sand, without heat being applied to re-heat them; and if so, have you used or seen in use such wheels; and if so, state time and place.

"Yes, I have seen them and been using them all the time; I have seen them made, and have been in when they were making them at Nash & Mowry's here; at Blanchard & Arnold's in Milwaukee, at Russell & Co's at Chicago, and at the shops of the Marietta and Cincinnati Road at Zaleski. From 1855 to the present time will cover the dates.

"Q. 7. What is the result of your experience and observation as to the wear and durability and market value of the wheels cooled in the manner last above described, as compared with the wear and durability and market value of the wheels made by Asa Whitney & Sons?

"My experience with the Whitney wheel—what I have had—has not been more than half as long as other makes. From the experience I have had, I wouldn't pay more than two-thirds as much for the Whitney wheel as I would for some other wheels. As to the market value I don't know how they compared with other wheels; I never had any Whitney wheels that wore over two-third what other wheels that were right alongside of them wore—I mean, to take them as a lot together."

C. B. Collier.

Rec., p. 286.

"I am a subscribing witness to the paper now produced and offered in evidence, purporting to be a license or partial assignment from George Keck to Albert L. Mowry, of Letters Patent granted on the 8th day of October, A. D. 1850, to Nathan Washburn for improvements in the manufacture of car wheels. I drew the instrument, saw Mr. Keck sign it, and deliver it to Mr. Mowry."

Albert L. Mowry.

"George Keck is at Louisville, Ky., or some other place down the river; I think I have the original deed of assignment to George Keck from Washburn of the Patent referred to in Mr. Collier's testimony; it was given to me by Mr. Keck; where it is now I do not know. The assignment was given to me for a valuable consideration; the consideration was this: I was to give him ten or twenty per cent. of the profits of my business for three years; that was the consideration of the assignment.

"Mr. Atwood brought suit against me for an infringement of his Patent; it was in Court several years; I finally settled with him and bought a right for Cincinnati and St. Louis, for which I paid him $2000 for the Cincinnati shop-right, and $1,000 for the St. Louis—that was in final settlement of that suit, we agreeing to have the suit dismissed at his costs.

"The deed from Atwood to me I have in my hands, (offered in evidence by Mr. Collier. It was delivered by me to Mr. Atwood.)"

Samuel First.

Testifies that the demand for wheels (Mowry's) has been greater in Rec., p. 287.

1868 than at any time since '63 and '64, and the Works are now making 36 wheels per day, with orders ahead.

That the wheels are simply slow cooled by being placed in pits which are made as nearly air tight as practicable.

Presents a statement of the number of wheels made and sold by Mowry from 1852 to April, 1861, showing a total of 20,056.

The Defendant here offered in evidence and filed the same as exhibits, the

1. Certified copy of re-issued Letters Patent, granted Anson Atwood, dated 22d Sept., 1857, number 497, for Cast Iron Railroad Wheels.

2. Certified copy of Letters Patent, granted John Murphy, dated August 7, 1849, number 6633, for Improved Method of Regulating the Contraction of Car Wheels.

3. Certified copy of Letters Patent, granted Anson Atwood, dated 15th May, 1847, number 5112, for Cast Iron Railroad Wheels.

4. Certified copy of re-issued Letters Patent, granted Anson Atwood, dated 9th of June, 1857, number 468, and the certificate of extension, for Railroad Car Wheels.

Certified copy of Letters Patent to Nathan Washburn, dated October, 1850, number 7710, for Washburn's Improved Car Wheels.

And the Certified copy of re-issued Letters Patent, granted Anson Atwood, dated 22d September, 1857, number 498, for Cast Iron Railroad Wheels.

David P. Green.

Manufacturer of Car Wheels at St. Louis.

Q. By what means, if any, have you cooled car wheels made by you?

A. From the time I commenced, up to 1863 or 1864, I cooled them in sand by covering them. From that time, some of the time I have not used sand, but have put them in a pit. I have used charcoal to see if it would make them any better. Sometimes we would use it for a few days, and then we would stop. After ceasing to use the charcoal we put them in pits and covered them up.

Q. What difference, if any, was there in the market value of wheels made by you and cooled in sand, and those made and cooled with the use of charcoal?

A. No difference at all.

Q. To whom did you sell wheels?

A. We used to sell them to the Northern Missouri Railroad, and to the Ohio and Mississippi Railroad; have sold some to almost all the railroads.

Q. What difference, if any, was there in the demand for wheels by reason of the use of the charcoal?

A. I never found any difference.

Testifies also to use of the Murphy process—that is, passing current of cold air through the hubs, the object of which is to have the hubs cool as fast as the plates, no fuel being used: that the process is advantageous.

George G. Lobdell.

Rec., pp. 310-317

Manufacturer of Car Wheels at Wilmington, Delaware.

Been in the business since 1833 without interruption. We place the wheels in a pit and cover them with hot sand, the wheels being removed from the moulds as soon as they will bear handling; commenced covering them with hot sand in December, 1847, or January, 1848; make, and have made by this process double and single-plate, and hollow-spoke and solid-spoke wheels.

Some years have made as high as 30,000 wheels. Largest customers have been the Philadelphia, Wilmington and Baltimore, the Pennsylvania Central, New York and Erie, Union Pacific, Union Pacific Eastern Division Railroads, besides very many others.

(Shown table of weights of Whitney's wheels). These weights are same as same sizes of wheels made by us, except three which are heavier, and one which is lighter.

Do not think Whitney's wheels any better than those made by us.

We have never knowingly sold our wheels for less than what we believed Whitney & Sons were asking for wheels of same diameter and description.

The Philadelphia, Wilmington and Baltimore Railroad buy very few wheels except from us; they occasionally buy four or eight wheels to try under an engine or car in connection with our wheels.

I believe our wheel will wear as long as any wheel that is made.

Prior to 1847, I have covered up with sand the rim and spokes of railroad wheels, thus excluding that part of the wheel from the air, and exposed the hub, and sometimes cooled it by pouring water in the hole made in the hub of the wheel, thus causing the different parts of the wheel to cool more nearly at the same time, but found this an uncertain process of cooling. This was prior to 1839, and at Wilmington.

Cross-Examination.

We never practised the slow cooling prior to 1839 to any extent.

Prior to the use of my present sand process we did not pit the wheel or cover them with sand as at present.

Do not sell our wheels either as annealed or unannealed wheels, but simply as wheels free from strain.

No competition between "annealed" and unannealed wheels.

Do not think the competition is between annealed and unannealed wheels, other things being equal; would make no difference to us as regards selling, whether the wheel was called an annealed wheel or not.

Some time ago a concern in Jersey City advertised and used a great deal of exertion in introducing what they termed an annealed wheel, claiming that by their process the plate of the wheel was made softer, consequently tougher, and that they could make a lighter wheel than without the use of their process. Some of those who had theretofore been our customers were induced to use some of these wheels, which did not prove what they were recommended to be.

This is the only instance that I know of our having lost the sale of wheels by wheels called annealed wheels coming in competition with ours.

+Q. 13. Is the Whitney wheel known in the trade as an annealed wheel?

Term "annealed" wheels applied to wheels cooled by sand process.

A. That is a pretty difficult question to answer, as the term annealed is improperly applied to both processes—the sand process and the Whitney process—from the fact that some makers and buyers call the sand process annealing. I believe Mr. Whitney sells his wheels as annealed wheels, and always has done so.

Q. 14. If a railroad man asks you whether you anneal by the sand process or by the furnace, what do you answer.

A. I should say we cover them up in hot sand: and if he asked me if that annealed them, I would say it prolonged the time of cooling so that all parts of the wheel would cool at the same time and be free from strain, without softening the chill or affecting it in any way injuriously.

Cost of our process of cooling not over $2 per day for 150 wheels.

Out of 1000 wheels cooled by my process none crack if properly covered with hot sand and removed in time from the moulds. In practice don't think we lose one in 500 from this cause.

Warrant our wheels to run a year, or as many miles as any wheel made.

Do not advise use of a very light wheel: have known 33-inch wheels of our make, weighing 480 pounds, to run for years under passenger cars.

Cost no more to finish up, when cool, the Bush & Lobdell (divided hub) wheel, than any other wheel.

Q. 28. Are you not of longer experience, and have you not greater skill in the manufacture of cast-iron railroad car wheels than any other person in the United States?

A. I believe I am the oldest manufacturer of chilled cast-iron car wheels

in the world, and that I have had a greater personal experience in the mixing and managing of cast iron used in chilled cast iron car wheels than any other person known to me. As to the skill, I prefer that others should answer.

Counsel for Defendant offers the following questions:

Q. 1. In view of your experience of which you have testified, to which process of cooling car wheels, Whitney's or the sand process practised by you, do you give the preference, and which in your opinion is most profitable to the manufacturer and produces the best wheel?

[Objected to by Plaintiff's Counsel, because the witness has had no experience of the Whitney process.]

A. I prefer the sand process. Can't speak as to which is most profitable, and believe that a wheel properly cooled in hot sand will be the best.

Q. 2. If your wheels were placed in previously heated ovens after their removal from the moulds, and there re-heated to a point "say a little below that at which fusion commences," and then allowed gradually to cool, as described in the Patent of Mr. Whitney, would they cost more or less than they cost as treated by you?

[Objected to by Counsel for Plaintiff.]

A. I have never used Mr. Whitney's process, and cannot say. My opinion is, that it would cost more by Mr. Whitney's process than by the sand process as used by us.

Q. 3. What, if anything, has the quality of the iron, the melting of the iron, the mixing of the iron, the pouring and the moulding of the wheel, the form of the wheel, or either of these things, to do with the utility and durability of the wheel?

A. All are important considerations in the manufacture of a perfect railroad car wheel.

Q. 4. State whether or not wheels slow cooled, as made by you prior to 1839, testified to in your examination-in-chief, were sold and used; if so, how many and how did they wear?

A. Yes, some of them were sold; they were the first wheels made of the Bush & Lobdell Patent, dated March, 1838. They were used on the Philadelphia, Wilmington & Baltimore Railroad. The number was few; I cannot say how many. They wore well. All so sold were tested before delivery.

Questions by Plaintiff's Counsel.

Q. 1. What has the chill to do with the utility and durability of a car-wheel?

A. On the character of the chill depends altogether the durability of the wheel so far as its wearing is concerned, but not as to its strength.

Q. 2. Does not the necessity of having a chill wearing surface to run on the rail, and the provision made for such surface by casting the wheel on a chill, create the necessity of providing some special means for counteracting the strains resulting from the contraction of the casting thus formed in cooling?

A. It does, unless the form of the wheel is such as to yield, or accommodate itself to the unequal cooling of the different parts of the wheel, as was in the case of the Bush & Lobdell, Eddy, and other plate wheels.

Questions by Defendant's Counsel.

Q. 1. What, in your opinion, is the effect upon the chill of a wheel if it is re-heated to a degree beyond that it has when taken from the mould, so soon as the wheel has cooled enough to be capable of being handled?

[Objected to as a question upon which the Court has passed.]

A. It would depend altogether upon the degree it was heated; if it was heated but slightly, it would not affect the chill, but it might be heated to a sufficient degree to soften the chill.

Q. 2. How, if heated to a point, "say a little below that at which fusion commences?"

[Objected to as irrelevant, in view of the decision of the Court in this case.]

A. I think that it would soften the chill.

GEORGE G. LOBDELL.

Horatio G. Brooks.

Superintendent of motive power of the Erie Railway.

Sec., pp. 320-321.

Q. State the result of your experience and observation as to the wear and durability of car wheels cooled by the sand process, which you have

described, as compared with the Whitney wheel, or any other wheel with which you are acquainted?

A. The use of the process of annealing I believe simply to be the gradual cooling, so that the unequal distribution of weight of metal in different parts of the wheel may, by a retained uniform temperature, be uniform throughout such unequal distribution of weight. The idea I wish to convey is that any unequal distribution of metal must be cooled gradually and uniformly by some process, in order to obtain the requisite strength in the material after it has cooled; and any process that will allow the material to be thus cooled, gradually, accomplishes the result desired.

I would not give anything for one of these processes over another. If I were going to make wheels, I would put them in a pit without sand and cover the top of the pit; cover them up tight; this accomplishes the desired result.

The result of my experience with all straight-plate wheels, such as Whitney uses, is not favorable to that form of wheel. I do not know that Whitney has ever made any wheels of what is called the Washburn pattern. I never have used any wheels but what were slow cooled. No one makes any to my knowledge that are not slow cooled by some process. The sand-cooled wheels and those cooled without sand in pits wear excellently well, I do not see any difference.

William W. Snow.

Manufacturer of Car Wheels at Ramapo, New York; engaged in business for fifteen years. Rec., pp. 322-324.

Until last two and a half years always used sand in pits, now cover the pits over, making them air-tight, without sand.

By this process have made nearly all forms of wheels that have been made, including single straight-plate, and double-plate wheels; and have made them in numbers from 20 to 135 wheels a day; now make from 100 to 135 per day. Sell principally to Atlantic & Great Western, Pennsylvania Central, Pittsburgh, Fort Wayne & Chicago, Central of New Jersey, New Jersey Railroad & Transportation Company, and Morris & Essex of New Jersey.

Our wheels are taken as a standard of excellence by all who are acquainted with them.

William Kidd.

Manufacturer of Wheels at Rochester, New York, from March, 1847, Rec. pp. 324-326.

to three years ago; purchased my foundry from R. G. Benedict, March 1847.

We pitted the wheels in a pit covered with dry sand; put them in red hot and leave them there thirty-six to forty-eight hours; usually two days. Think there never was any better cast-iron wheel than we made; commenced furnishing the Western Division New York Central R. R. at time of consolidation, and they continue with same establishment now.

Cross-Examination.

At first made so-called "Wiser wheel;" also made double-plate wheel, similar to Bush & Lobdell's; afterwards we purchased the right under Washburn's and Atwood's Patents; think the Wiser wheel had solid hub; the double-plate wheel had a solid hub.

Dried the sand by throwing it on hot castings; it would accumulate so as to give us sufficient quantity afterwards.

Re-Direct-Examination.

Found a large annealing pit in the foundry when I bought, large enough to hold sixteen to twenty wheels.

Re-Cross-Examination.

Q. Have you designated the wheels which you have made as annealed wheels?

A. Yes. The wheels were annealed wheels. The process of putting them in a pit and cooling them slowly was what we called annealing.

Asa Whitney.

Rec, pp. 326-336.

Is asked to give a history of his invention, patented April 25, 1848, which he proceeds to do, the substance of which is that he completed a pattern of wheel that he thought most favorable, and cast several wheels therefrom and subjected them to annealing in pits constructed to heat wrought-iron tires to set on driving wheels; that this was in February, 1847; and that in February or March, 1847, he hired a foundry on Willow street, and commenced the manufacture of wheels.

As far as his personal knowledge extends, prior to 1847, wheels were made with spokes and hubs split, and as soon as cast, were taken from the moulds and cooled in the open air. Referring to wheels of Lobdell's make, says understands they left them in the moulds to cool.

Cross-Examination.

On cross-examination the witness states that the wheels as first made by him were corrugated single-plate, solid hub-wheels; that he anneals wheels at the present time in same manner as when he commenced on Willow street, except the furnaces are better adapted to get a uniform result; that there was danger in the first furnaces of heating the wheels in the bottom of the pit too much, and those in the top not enough.

+Q. 16. Do you apply the same degree of heat to your wheels to anneal them now that you did on Willow street?

A. Yes, but it is uniformly distributed through all the wheels in the pit now; it was not so easy then to heat all the wheels to the same temperature as it is in the improved furnaces.

+Q. 17. State what that degree of heat is, and how near the point of fusion?

A. We aim to raise the temperature of all parts of the wheel to that of the hottest part of it when taken from the mould.

Whitney's process as practised; "*aims to raise the temperature of all parts of the wheel to that of the hottest part when taken from the mould.*"

+Q. 18. What is the hottest part when taken from the moulds?

A. The hub, the thickest part.

+Q. 19. What degree indicates the fusing point of iron?

[Objected to as not relevant, not pertinent, not competent and not cross-examination.]

A. The books say about 2700° Fahrenheit. In my own experience I have never undertaken to determine.

+Q. 20. About what degree of heat have the hubs when removed from the moulds to the annealing ovens as practised by you?

[Objected to on same grounds as preceding question.]

A. That I can't tell. We have no instrument to measure temperature—we never attempt it except by the appearance of the wheel to the eye.

+Q. 21. Do you not know that it is hundreds of degrees below the fusing point?

[Objected to same as preceding question, going into matter already disposed of by the Court.]

A. My answer is the same as the preceding question. We cannot measure the temperature—we never attempted it.

+Q. 22. +Q. 21 repeated.

[Objection repeated.]

A. I have stated that we have no means of determining. We know that it is less than fusion, because otherwise the hub would bleed, but how much I don't know.

+Q. 23. Were the furnaces at your foundry on Willow street made in accordance with the diagram annexed to your Letters Patent?

[Objected to as before.]

+Q. 33. In your examination taken on the 27th day of August, 1867, before Charles Sergeant, Special Examiner in this case, you testified that from 1850 to 1861, both inclusive, you were paid a dollar a wheel aside from your proportion of the profits of the business, and you annexed an exhibit to your deposition showing the payment of $237,494 to you by A. Whitney & Son. Was that amount actually paid to you?

[Objected to because the witness had not so testified, but has testified that said amount was charged to the expense account of the business, and the witness is shown a copy of his said answer.]

A. That amount was paid as stated in the testimony then given; of course I had to bear my proportions of the dollar a wheel as an element of the expense account, like pig iron or anything else. The firm paid me a dollar a wheel, and I was a member of the firm and had to bear my proportion of the expenses. The rest of the dollar a wheel came to me individually. I was credited with a dollar a wheel, and if I took out cash it was debited to me.

+Q. 34. What was your interest during that period in the business, and your proportion of the expenses?

A. My interest from 1850 to 1851 was a constantly varying one. To 1851 I had two-thirds—then I gave to my sons, John and James, as they came of age, interests in my business.

[The Counsel for Defendant at this stage of the cause produced and introduced in evidence certified copy of the files in matter of application of Asa Whitney for an *extension* of his said Letters Patent, including an *argument*, and a *sworn statement* signed by him [see printed record, pp. 358–390.], and the witness was subjected to a lengthy examination relative thereto.]

In your statement filed in connection with your application for extension the following language occurs:

"*Profits.* I believe there is no essential difference in the cost per pound

"of making cast-iron chilled car wheels of the various patterns, and by "the different modes in use, providing the same skill and system control "the manufacture."

Is this now your opinion?

[Objected to.]

A. That is still my opinion.

+Q. 42. In the statement and account filed in connection with your said application for extension of your receipts and disbursements connected with said Patent, you omitted, did you not, to set forth the royalties or license fees, amounting to $237,494, paid to you by the firm of A. Whitney & Sons, as heretofore testified to by you, and a schedule of which is annexed to your deposition heretofore taken in this case, and found on page 6 of the printed copy of such testimony now exhibited to you?

A. I see no item in the paper handed me in which the cost of the wheel and the price for which they were sold is referred to. I don't see in this statement that the item of royalty could be entered. I did not deal with it at all, for the purpose for which this paper was drawn, it was not requisite to show the object I had in view. That statement has nothing to do with the profits of the wheels.

+Q. 43. For what purpose was the statement and account prepared?

A. To show the justice of extending the Patent that was then about to expire.

+Q. 44. And yet you omitted, did you not, to set forth in said account the payment of the royalties for the use of said Patent, which you have heretofore testified to have been paid to you?

[Objected to.]

A. I can only repeat the answer I gave to the previous question.

+Q. 45. +Q. 44 repeated.

[Objected to.]

A. I repeat the same answer.

+Q. 46. In your said statement the following language occurs: "But "by my process I am enabled to make them lighter than those made in "any other way for a similar service, and I can, therefore, afford to sell "them at the same price per wheel as the other makers, and save the cost "of the difference in weight. This saving of metal, therefore, I deem to "measure the essential advantage I have over my competitors, and also "the profits arising from my Patent."

If you are incorrect in your hypothesis that you are enabled by your said process to make the wheels lighter than those made for similar service in any other way, then there is no saving or profit to the manufacturer by the use of your process, is there? If so, specify what saving or advantage there is?

A. The advantage that I claim for my wheel is its greater durability and safety, which gives me a large amount of business, as has been shown by the quantity we have made as compared with other makers.

+Q. 47. If those made by other makers who cool their wheels in sand or in pits are as light as those made by you for similar service, what advantage have you over them by reason of your patented process in the cost of manufacturing such wheels?

A. The greater safety and durability (besides I have always esteemed the pitting or covering the wheels with hot sand as an invasion of my Patent. It was never done, to my knowledge, until after I had commenced manufacturing and annealing the wheels as described in my Patent).

[The counsel for Defendant objects to that portion of the answer included in parenthesis, as being in no way responsive to the question, and wholly incompetent for any purpose as testimony.]

+Q. 48. +Q. 47 repeated.

A. I repeat my answer.

+Q. 49. Under the circumstances assumed in +Q. 47, do your wheels cost more or less to manufacture than those cooled in sand or in pits, without reference to the sale of such wheels?

[Objected to for ambiguity, inasmuch as the Complainant's wheels are also cooled in pits.]

A. I don't think there is any essential difference in the cost of making. I don't know of any with the same system and arrangement for the manufacture as we have.

+Q. 50. Have you, during the term of your Patent, sold your wheels at a greater market price than those made by other manufacturers who cool them in pits with or without sand, or at a less or the same market price, and state in your answer with what manufacturer, if any, you institute the comparison?

[Objected to so far as it assumes that during the term of the Patent, wheels were cooled in pits with or without sand.]

A. We have always fixed the price of our wheels at as low a figure as we could afford to make them, without reference to the price of other

manufacturers. Our prices have generally been lower; when we first alter prices, other manufacturers immediately come down to our prices. *The only manufacturer that we compete with, to any extent, is Mr. Lobdell,* of Wilmington. They have, in a few instances that we have known, put the prices a fraction lower than ours.

Re-Direct-Examination.

Q. 5. Does your Patent of April 25th, 1848, describe the best mode known to you at the time of your application for said Patent, for carrying out the process therein described?

A. Yes.

Q. 6. In your application for the extension of your Patent, if you had an attorney, state who it was?

A. I employed George Harding of this city.

Q. 7. Were your papers in the matter of said application prepared according to Mr. Harding's instructions as your Counsel?

A. They were.

Re-Cross-Examination.

+Q. 51. Did you make known to Mr. Harding, before or at the time of the preparation of said papers, the fact of the payment to you of the royalties by your firm and by another license in Pittsburg which you have testified to heretofore in this case?

A. I do not remember. I do not recollect that I did.

Sworn Dec. 19th, and subscribed before me this 21st day of Dec., A. D. 1868. } A. WHITNEY.

WM. B. DAYTON,
Notary Public and Special Commissioner.

[SEAL.]

George Burnham.

Examined solely as to the date of Mr. Whitney's invention, and testifies to annealing of wheels by Whitney in the early part or middle of 1847, and produces an entry from books of M. Baldwin, under date of June 30, 1847, referring to experiments with patent wheel, with marginal entry "1 or 2 wheels; 3 or 4 do.; 1 cooked; all broken up;" "the entries just above extend from April 26 to June 12." Think the wheels were cast and annealed during the winter or spring of 1847; can't say I saw them annealed; knew from their condition they had been annealed. Rec., pp. 336-338.

Charles T. Parry.

Rec., pp 338.

Examined solely relative to Whitney's experiments in 1847.

Q. 6. Did you know, at any time, of any experiments made by said Whitney, in the manufacture of cast-iron car wheels; and if yea, when?

A. I knew there were such experiments made, and it was in the spring of 1847, to the best of my knowledge, immediately after the retiring of Mr. Whitney from the firm.

Q. 7. In what did his experiments at that time consist?

A. They consisted in making a car wheel with curved, corrugated disc—solid hub.

The witness then describes the process by which they were annealed: placed in a furnace, covered with fine coal, cinders, &c.; impression is fire was heated up afterwards, &c.

Q. 11. Can you state when George Whitney made the patterns from which these wheels were cast?

A. In the spring of 1847.

Cross-Examination.

+Q. 16. Do you know about what temperature the hottest part of the wheel was when put into the oven; if so, will you please state it?

A. I know that it was red hot, but cannot say now whether it was a light red or a dark red.

+Q. 17. Can you approximate as to how far or how many degrees it was below the point of fusion?

A. No. I am not sufficiently versed in temperatures to express it by degrees. My impression is that a red heat is from 800 to 1000 degrees.

George H. Kirk.

Rec., p. 342.

Examined solely relative to the number of wheels sold by A. Whitney & Sons from 1861 to 1868, and presents a statement thereof as compiled from the books of said firm, showing sales of 328,841.

No other testimony on behalf of the Complainant, under the order re-committing case to the Special Master.

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c., pp. 338.

Abstract of Extension Record of A. Whitney, introduced by Defendant.

STATEMENT BY ASA WHITNEY.

Prior to my Patent for annealing or prolonging the cooling of cast-iron

car wheels, I had experimented in a comparatively
best means to be employed to accomplish the object d

Copies of the drawings of the first furnaces or ch
pose are attached to the Patent.

The trials made *in the manner described in the sch*
Patent were satisfactory so far as the soundness of th
the improvement rested was concerned, but *practicall*
the furnaces or chambers were defective, rendering gre
their attendance.

There was found to be *too much heat applied to th*
wheels in the pile, and *not enough to the top ones.* T
bottom *were exposed to a temperature so high*, or *so nea*
as to destroy or impair the chill; and the temperature
the top was not raised high enough to relieve the
acquired; while the object desired was accomplished o
pile, those wheels being relieved from all inherent stra
being injuriously affected by the heat they had been e

* * * * *

In the spring of 1847, in company with my son
small foundry in this city, in which, *early in the follo*
menced to prepare for *casting and treating wheels in t*
in the schedule attached to the Patent referred to.
these annealing chambers erected; the wheels remaine
three days; consequently only one could be emptied
We continued to use them, however, without mater
September, 1849. *They were not only defective in th*
noted, but they lacked capacity for more than twelve wh
the demand for them began to exceed that number.

* * * * *

It is true, the chill may be impaired or entirely dest
temperature in the annealing chambers too high. This
quently while we used the first set of annealing cha
quently, *although it occasionally happened* in the use
less frequently in the *third*, and never in the *fourt*
Some of the first of these overheated wheels that escape
inspection they were subjected to, were put in use; *t*
formed very little service. The fact, however, that th
by the annealing process was extensively used by ou
confirmation of the truth of their prediction in the pr
than half the term for which the Patent was granted h

ts that under the
22d, 1868, he has
O'Donnell, James
Collier, Albert L.
s produced before
l there have been
eorge G. Lobdell,
ld, Asa Whitney,
Kirk, which, with
ments referred to
are also herewith
l filed as exhibits
ed:
anted Anson At-
cast-iron railroad
hn Murphy, dated
hod of regulating
on Atwood, dated
wheels.
d Anson Atwood,
of extension for
nburn, dated 18th
ed car wheels.
d Anson Atwood,
n railroad wheels.
Asa Whitney, and
an extension of
improvement in
he Examiner's re-
the Master—to
n, if any, of the
, by him, of the
o testimony has
ment of the total
of the nineteen
heels referred to
herein, so as to

car wheels, I had experimented in a comparatively small way as to the best means to be employed to accomplish the object desired.

Copies of the drawings of the first furnaces or chambers for that purpose are attached to the Patent.

The trials made *in the manner described in the schedule attached to the Patent* were satisfactory so far as the soundness of the *theory* upon which the improvement rested was concerned, but *practically* it *was shown that the furnaces or chambers were defective*, rendering great care necessary in their attendance.

Defects of Whitney's process, as patented; *destroys the chill*, &c.

There was found to be *too much heat applied to the two or three lower wheels in the pile*, and *not enough to the top ones*. Those at and near the bottom *were exposed to a temperature so high*, or *so near the point of fusion as to destroy or impair the chill;* and the temperature of those at and near the top was not raised high enough to relieve them from the strain acquired; while the object desired was accomplished on the residue of the pile, those wheels being relieved from all inherent strain, and the chill not being injuriously affected by the heat they had been exposed to.

* * * * * * *

In the spring of 1847, in company with my son George, *we hired a small foundry in this city*, in which, *early in the following June*, we *commenced to prepare* for *casting and treating wheels in the manner described in the schedule attached to the Patent referred to.* There were three of these annealing chambers erected; the wheels remained in each of them three days; consequently only one could be emptied and refilled daily. We continued to use them, however, without material alteration until September, 1849. *They were not only defective in the particulars before noted*, but they lacked capacity for more than twelve wheels per day, while the demand for them began to exceed that number.

* * * * * * *

"Chill" destroyed by too great heat.

It is true, the chill may be impaired or entirely destroyed by raising the temperature in the annealing chambers too high. This occurred more frequently while we used the first set of annealing chambers than subsequently, *although it occasionally happened* in the use of the *second set*, less frequently in the *third*, and never in the *fourth set*, now in use. Some of the first of these overheated wheels that escaped detection by the inspection they were subjected to, were put in use; *they, of course, performed very little service.* The fact, however, that they were so injured by the annealing process was extensively used by our competitors as a confirmation of the truth of their prediction in the premises, until more than half the term for which the Patent was granted had expired, and we

had expended more than $50,000 in erecting successively improved structures to accomplish the object aimed at.

* * * * * * *

Loss sustained by Whitney during original term of his Patent, $14,624,31.

The cost of experiments and *changes of structures for developing the improvement patented* has exceeded the profits, as before stated thus :

Say expenses, ...	$52,970 31
Say profits, ...	38,346 00
Deficit, ...	$14,624 31

* * * * * * *

PROFITS.

Sole advantage of Wiitney's Patent as measured by himself; an alleged saving metal, 10 lbs. per wheel.

I believe there is no essential difference in the cost per pound of making cast-iron chilled car-wheels of the various patterns and by the different modes in use, providing the same skill and system control the manufacture; but by my process I am enabled to make them *lighter* than those made in any other way for a similar service, and I can, therefore, afford to sell them at the same price *per wheel* as other makers, and save the cost of the difference in weight. *This saving of metal, therefore, I deem to measure the essential advantage I have over my competitors, and also the profits arising from my Patent.*

* * * * * * *

STATE OF PENNSYLVANIA,
CITY AND COUNTY OF PHILADELPHIA, } *ss.*

Asa Whitney, being duly sworn, doth depose and say that the annexed statement and account is correct.

(Signed) A. WHITNEY.

Sworn and subscribed before me, this 4th day of February, A. D. 1862.

[SEAL] CHAS. E. PANCOAST,
Alderman.

REPORT OF GEORGE R. SAGE, SPECIAL MASTER PURSUANT TO THE ORDER OF THE COURT, ENTERED OCTOBER 22, 1868.

To the Hon. the Judges of the Circuit Court of the United States, within and for the Sixth Circuit and Southern District of Ohio, in Chancery sitting.

The undersigned Special Master respectfully reports that under the order entered in the above-entitled cause October 22d, 1868, he has taken the depositions of William Cullen, Jerry O'Donnell, James Lamb, William Clough, Alvin A. Stone, Charles B. Collier, Albert L. Mowry, Samuel First and David P. Green, witnesses produced before him by the parties, and herewith files the same; and there have been taken and submitted to him the depositions of George G. Lobdell, Horatio G. Brooks, William W. Snow, William Kidd, Asa Whitney, George Burnham, Charles T. Parry and George H. Kirk, which, with the exhibits, transcripts, tables, statements and documents referred to by the witnesses and annexed to their depositions, are also herewith filed. There have also been offered in evidence and filed as exhibits the following certified copies, which are herewith filed:

1. Certified copy of re-issued Letters Patent, granted Anson Atwood, dated 22d September, 1857, Number 497, for cast-iron railroad wheels.

2. Certified copy of Letters Patent, granted John Murphy, dated August 9th, 1849, Number 6633, for improved method of regulating the contraction of car wheels.

3. Certified copy of Letters Patent, granted Anson Atwood, dated 15th May, 1847, Number 5112, for cast-iron railroad wheels.

3. Certified copy of re-issued Letters Patent, granted Anson Atwood, dated 9th June, 1857, Number 468, and the certificate of extension for railroad car wheels.

5. Certified copy of Letters Patent to Nathan Washburn, dated 18th October, 1850, Number 7710, for Washburn's improved car wheels.

6. Certified copy of re-issued Letters Patent, granted Anson Atwood, dated 22d September, 1857, Number 498, for cast-iron railroad wheels.

Also, certified copy of statement and account of Asa Whitney, and of his argument in the matter of his application for an extension of Letters Patent, granted to him April 25th, 1848, for improvement in annealing and cooling cast-iron car wheels; also, of the Examiner's report thereupon.

To the first proposition submitted by the Court to the Master—to ascertain and report to the Court, "what proportion, if any, of the profit made by the said Defendant was due to the use, by him, of the Complainant's invention;" the Master reports that no testimony has been offered to enable him to make an apportionment of the total profit derived from the manufacture by the Defendant of the nineteen thousand eight hundred and nineteen cast-iron car wheels referred to by the Master in the first finding of his original report herein, so as to

credit a portion to the material used, and to the processes employed in their manufacture up to the time of their removal from the moulds, and the remainder to the processes of re-heating and slow-cooling, and the Master is therefore unable to report any division of profits; the Master further reports that the questions submitted to him have been argued by Counsel, and they differ widely as to what is included in the Complainant's invention and Patent, and as to the construction of the Patent by the Court: the Master does not consider it within his province to attempt to construe the Patent, and therefore reports in the alternative.

I. If, as is claimed by Complainant's Counsel, the entire process of re-heating and prolonged cooling used by the Defendant in the manufacture of said wheels was an infringement of the Complainant's Patent, the Master finds that the total profit realized by the Defendant from the manufacture and sale of said wheels was due to the use by him of the Complainant's invention.

II. If, as is claimed by Defendant's Counsel, there is no infringement of the Complainant's Patent unless the wheels are subjected to the process of re-heating, that is to say, if the process of slow-cooling used in connection with the re-heating is old, and not a part of the Complainant's invention, nor included in his Patent, the Master finds that no part of the profit realized by the Defendant from the manufacture and sale of said wheels was due to the use by him of the Complainant's invention.

III. The Master finds that had said wheels, manufactured by the Defendant, been left to cool in the open air, they would have had no market value as car wheels. They would have been worth only the value of the iron of which they were made. Re-heating in connection with slow-cooling, or slow-cooling without re-heating, is indispensable to make marketable cast-iron car wheels of the configuration of those made by the Defendant.

IV. The Master finds that there is no re-heating process for the manufacture of cast-iron car wheels, outside of the Complainant's Patent.

V. The Master finds that the wheels aforesaid could have been removed from the moulds and finished without being subjected to the re-heating process.

1st. By placing them in pits as soon as they could be handled, covering them with hot sand, and thereby slow-cooling them.

2d. By placing them in like manner in pits without any fuel, cover, ing the pits, leaving the wheels in the pits, and thereby slow-cooling them.

The Master finds that wheels so manufactured have, and did have from April 1st, 1861, to April 9th, 1867, a market value equal to that

of wheels manufactured by the use of the process complained of in this cause.

Complainant's Counsel asked for the following findings:

1st. That the wheels of which the Master has taken an account, made and sold by the Defendant, were annealed wheels, and were sold as annealed wheels.

This I adopt as a finding and hereby report it as such to the Court.

2d. That the process patented to the Complainant, and as found by the Court, used by the Defendant in the manufacture of said wheels, conferred upon them their entire market value, and their entire value above their weight in iron.

If the Court shall decide that the Complainant's Patent included prolonging the time of cooling the wheels as used by the Defendant, I adopt this as a finding; but if the Complainant's Patent covers only the application of extraneous heat to the wheels after they are taken from the moulds, I decline to make this finding.

3d. That no process of annealing in connection with prolonging cooling of cast iron car wheels, other than that patented to the Complainant, April 5th, 1848, and that described in the Patent of May, 1861, appears to be, or to have been, known in the manufacture of cast-iron car wheels.

Taking annealing to mean re-heating in connection with slow cooling, I adopt this as a finding, and report it as such.

4. That the said wheels, made by the Defendant, required no treatment other than that described in the said Patent of Complainant, to complete them as annealed wheels.

This I adopt as a finding, and report it as such to the Court.

5. That the said annealed wheels, made and sold by the Defendant, could not have been made by any process outside of the Complainant's Patent.

This will be considered in connection with the requests by Counsel for Defendant, as follows:

I am requested by Counsel for Defendant to embody in my report the specific inquiries addressed to me by the Court, and to answer them in the affirmative or negative, as the fact may appear.

"First. Whether the wheels made and sold by the Defendant had or could have been made to have any market value without being subjected to the process patented to the Complainant."

"Second. If they had, or could have been made to have, such value

by any annealing or slow-cooling process outside of the Complainant's Patent, how much additional and greater market value, if any, they derived from being subjected to said patented process?"

I find that said annealed wheels—using the term annealed in the sense above indicated—could not have been made by any process outside of the Complainant s Patent. The application of extraneous heat in the manner described in the Complainant's Patent, and as used by the Defendant in the manufacture of said wheels, retrieves the metal in some degree from the strain which begins the moment the wheels are cast, and in so far as that is accomplished, the wheels are strengthened, and their liability to break overcome. This retrieving is accomplished only by the application of extraneous heat, and extraneous heat cannot be applied without infringing the Complainant's Patent. Precisely the wheel, then, that the Defendant manufactures, could not have been manufactured without using the process patented to the Complainant or its equivalent. But I find that wheels of the material, size, shape and weight of those manufactured by the Defendant, could have been manufactured without the use of extraneous heat, and at less cost, by either of the methods described in finding V. of this report, and that wheels so manufactured would have had the same market value, in the market where the Defendant sold said 19,819 car wheels, as if extraneous heat had been applied to them as described in the Complainant's Patent, or as used by the Defendant.

Respectfully submitted,

GEO. R. SAGE,
Special Master.

March 23*d*, 1869.

Master's fees on re-committal, $1000.

DEFENDANT'S EXCEPTIONS.

The Defendant above named, by his Counsel, excepts to each and every part of the report of the Special Master in said cause, dated March 23d, 1869, except those parts thereof hereinafter quoted, to wit:

"V. The Master finds that the wheels aforesaid could have been removed from the moulds and finished without being subjected to the reheating process:

"1. By placing them in pits as soon as they could be handled, covering them with hot sand, and thereby slow-cooling them.

"2. By placing them in like manner in pits, without any fuel, covering the pits, leaving the wheels in the pits, and thereby slow-cooling them.

"The Master finds that wheels so manufactured have, and did have from April 1st, 1861, to April 9th, 1867, a market value equal to that of wheels manufactured by the use of the process complained of in this cause. * * * * * * *

"But I find that wheels of the material, size, shape and weight of those manufactured by the Defendant, could have been manufactured without the use of extraneous heat, and at less cost by either of the methods described in finding V. of this report, and that wheels so manufactured would have had the same market value, in the market where the Defendant sold said 19,819 car wheels, as if extraneous heat had been applied to them as described in the Complainant's Patent, or as used by the Defendant."

And the Defendant excepts to finding I. of said report, inasmuch as it assumes that no interpretation or construction has been given to the Complainant's Patent by the Court; whereas an interpretation had been so given, as was well known to the Master, and the construction placed on said Patent by the Master, as the hypothesis of said finding, is directly in conflict with the Court's construction, and said finding is therefore contemptuous of the Court.

Again, upon any construction of said Patent, said finding is wholly unwarranted by the testimony, or by any part of it.

And the Defendant excepts to findings III., IV., and to all that part of the report which commences with the words, "Complainant's Counsel asks for the following findings," and ends with the words, "Precisely the wheel, then, that the Defendant manufactured, could not have been manufactured without using the process patented to the Complainant, or its equivalent."

And the Defendant, by way of stating more specifically his exceptions, refers to the first inquiry addressed to the Master as contained in the order of the Court, to wit:

First.—Whether the wheels made and sold by the Defendant had, or could have been made to have, any market value, without being subjected to the proeess patented to the Complainant?" and says that the Master has refused to answer such inquiry, categorically, as requested by Defendant's Counsel, and, instead of so answering, has inserted an *argumentative* finding which conveys, by way of implication, that which is calculated to deceive and mislead the Court.

And the Defendant excepts to so much of the said findings and report

as may be construed to mean that the 19,819 car wheels made and sold by the Defendant had any greater market value by reason of the application to them of extraneous heat in the annealing pits, than they would have had if they had been left to cool there by a retention of their own heat—for the reason that the *entire* testimony taken pursuant to the order of the Court, including the testimony ot the Complainant, shows that no additional market value is given to car wheels by the application to them of extraneous heat in the process of cooling them.

And the Defendant craves leave to refer to the testimony offered before the Master, and filed by him at the hearing hereof.

CHAS. B. COLLIER,
Solicitor for Defendant.

COMPLAINANT'S EXCEPTIONS TO MASTER'S REPORTS.

Filed April 23d, 1869.

Having taken objections to the draft of said report, and said objections so taken having been overruled by the Master, the Complainant now takes to this Honorable Court exceptions to said report as returned and filed by said Master in the following particulars, to wit:

To the following finding of said report, viz.:

"1. If, as is claimed by Defendant's Counsel, there is no infringement of the Complainant's Patent, unless the wheels are subjected to the process of re-heating—that is to say, if the process of slow cooling used in connection with the re-heating is old, and not a part of the Complainant's invention, nor included in his Patent — the Master finds that no part of the profits realized by the Defendant from the manufacture and sale of said wheels was due to the use by him of the Complainant's invention."

Complainant excepts—

1. Because there was no evidence to show that the process of slow-cooling was old, nor to justify the Master in finding that it was old.

2. Because, in point of fact, not only the entire process described in the Patent, but each part of such entire process, was the invention of the Complainant, and the use of any material, substantial and essential part of such entire process — the slow-cooling being a substantial, material and essential part, whereby only an improved chilled cast-iron railroad car wheel could be made, and beneficial effects, the same in kind, if not in degree, attained, that were attained by the Complainant's entire process — is an infringement of Complainant's Patent, and the profits derived from the use of such material, substantial and essential part should be accounted for in this case.

3. Because it is not a legitimate subject of inquiry, what would have been the possible profits from using some other than the patented process; but the true inquiry is, what were the actual profits from using the patented process which the Defendant did use?

4. Because the evidence does not warrant the Master in finding that the Defendant would or could have made, by using the slow-cooling alone, the same profit which he did actually realize from using the entire process which the Defendant did in fact use.

To the following finding of said report, viz.:

"V. The Master finds that the wheels aforesaid could have been removed from the moulds and finished without being subjected to the re-heating process:

"1. By placing them in pits as soon as they could be handled, covering them with hot sand, and thereby slow-cooling them.

"2. By placing them, in like manner, in pits, without any fuel, covering the pits, leaving the wheels in the pits, and thereby slow-cooling them."

Complainant excepts—

1. Because the testimony shows that the hot-sand process is an annealing or re-heating process, and none of the evidence warrants the Master in finding that it is not a re-heating process.

2. Because the evidence does not warrant the Master in finding that placing the wheels together in a covered pit, hermetically sealed, does not attain in some degree the benefit of re-heating or of the re-heating process described in the Complainant's Patent, and by the use of a substantial part of the means therein indicated.

3. Because, in point of fact, not only the entire process described in the Patent, but each part of the entire process, was the invention of the Complainant, and the use of any material, substantial and essential part thereof (the slow cooling in such covered pits being such a substantial,

material and essential part), whereby only an improved chilled cast-iron railroad car wheel could be made, and beneficial effects, the same in kind, if not in degree, attained, that were attained by the Complainant's entire process, is an infringement of the Complainant's Patent, and the profits derived from the use of such material, substantial and essential part should be accounted for in this case.

To the following finding of said report, viz:

"The Master finds that wheels so manufactured have, and did have from April 1st, 1861, to April 7th, 1867, a market value equal to that of wheels manfactured by the use of the process complained of in this cause."

Complainant excepts—

Because the evidence does not warrant the Master in finding that wheels so manufactured have and did have, a market value equal to that of wheels manufactured by the use of the process patented to the Complainant.

And to the following finding of said report, viz:

"But I find that wheels of the material, size, shape and weight of those manufactured by the Defendant, could have been manufactured without the use of extraneous heat, and at less cost, by either of the methods described in finding V. of this report, and that wheels so manufactured would have had the same market value, in the market where the Defendant sold said 19,819 car wheels, as if extraneous heat had been applied to them, as described in the Complainant's Patent or as used by the Defendant."

Complainant excepts—

Because the evidence does not warrant the Master in finding that wheels of the size, shape and weight of those manufactured by the Defendant could have been manufactured without the use of extraneous heat, and at less cost by either of the methods described in finding V. of said report; and that wheels so manufactured would have had the same market value in the market where the Defendant sold said 19,819 car wheels, as if extraneous heat had been applied to them, as described in the Complainant's Patent or as used by the Defendant.

In which foregoing particulars said Complainant submits that the said report ought to be amended and altered as aforesaid.

HENRY BALDWIN, Jr.,
Of Counsel.

April 20th, 1869.

United States Circuit Court,

SOUTHERN DISTRICT OF OHIO.

ASA WHITNEY) No. 534.
vs. IN EQUITY.
ALBERT L. MOWRY.) FINAL DECREE. ENTERED OCT. 4, 1870.

This cause having been heard upon the exceptions to the original and supplemental reports of George R. Sage, Esq., the Special Master appointed herein, and having been argued by Counsel for the respective parties at the last term of this Court, thereupon, and upon consideration thereof, it is ordered, adjudged and decreed as follows, to wit:

First.—That of the Complainant's several exceptions to said reports, the second and third exceptions to the second (II.) finding of the said supplemental report, dated March 23d, 1869, be, and the same are hereby sustained.

Second.—That the other several exceptions of the Complainant to said reports be, and the same are hereby overruled.

Third.—That the several exceptions of the said Defendant to said reports be, and the same are hereby, overruled.

Fourth.—That the second (II.) finding of the said Master's report in the case, dated March 23d, 1869, be, and the same is hereby overruled.

Fifth.—That the said Master's reports in this case, excepting said second (II.) finding, be, and the same are hereby confirmed.

Sixth.—That the profits made by the said Defendant, in violation of the rights secured to the said Complainant by the Letters Patent No. 5531, granted to him April 28th, 1848, and extended for seven years from the 25th of April, 1862, in this case, amount to ninety-one thousand five hundred and one dollars and eighty-six cents. ($91,501 86.)

Seventh.—That the said Defendant do pay to the said Complainant, within ten days from the entering of this decree, the sum of ninety-one thousand five hundred and one dollars and eighty-six cents ($91,501 86); and the further sum of nineteen thousand nine hundred and eighty-four dollars and twenty-one cents, ($19,984.21), being interest on said principal sum to the 1st day of August, 1868; and the further sum of ten thousand nine hundred and eighty dollars and twenty-two

cents ($10,980 22,) being interest on said principal sum from August 1st, 1868, to the 1st day of August, 1870; and the costs in this case, to be taxed—

with interest from the 1st day of August, 1870, on the aggregate of said sums other than costs; and, in default of the payment of said sums as aforesaid, or any part thereof, that execution issue therefor, as in cases at law.

And now, from the said foregoing decree, the Defendant prays the allowance of an appeal to the Supreme Court of the United States, which is hereby allowed.

This cause having been heard at the last term of the Court, upon the motion submitted by Defendant for leave to vacate the interlocutory decree of April 5th, 1867, and amend his answer by setting up that the extension of the Patent in the bill of complaint set forth was obtained by the Complainant by means of fraud and perjury, and the same having been argued by Counsel for the respective parties, and having been duly considered by the Court, it is thereupon hereby ordered, adjudged and decreed, that the same is hereby overruled; to which order and decree, as above, the said Defendant prays an appeal to the Supreme Court of the United States, which is allowed.

The record also includes the motion, and amended motion, and affidavit of the Defendant—appellant—to vacate the original decree, &c.; the appeal bond, notice of appeal, petition, &c.